Overview of Infrastructure Charging, part 4, IMPROVERAIL Project Deliverable 9, "Improved Data Background to Support Current and Future Infrastructure Charging Systems"

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1 Report summary fiche

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2 Executive summary

2.1 General results

2.1.1 Objectives for a new charging methodology

The recent efforts undertaken by the European commission towards the implementation of Railway reforms have paved the way for drastic changes in the way railways are managed. A new vision for railway underlies this reform, which appears as a result of the continuous declining performance on a transport sector traditionally steered by public service concerns, loosing ground for other more flexible transport concepts such as those practised on the road.

This new approach is understood as crucial not only for the survival of the railway sector but also for its possible growth potential. Increased environmental concern associated especially with road transport has increased the motivation for improving railway sector's performance. This provides a unique chance for the successful renovation of railway, should it be able to cope with key market requirements not only in the traditional passengers segment but also and particularly, in freight traffic segments.

This new reality will have an impact on passengers, shippers, and train operators as well as the infrastructure managers. The infrastructure managers in Europe are therefore facing a whole new set of challenges and opportunities, but also face serious risks and obstacles.

The step envisaging the separation between provision of train services and the infrastructure management has provided the basics for a new business concept among operators and for new strategic decisions to be made regarding the provision of railway infrastructure for a new millennium. Creating a cleft between the passengers, shippers and other end-users and the infrastructure manager creates a **need for feedback** between operators and infrastructure managers in order to ensure a rational production.

This cleft suggests that implementing a market structure that creates feedback in the form of financial flows is a good tool for a healthy railway production. Such a system should take into account the:

- Welfare of end-users. The provision of railway services should meet the end-users demands.
- Cost structures. Both internal and external costs should be reflected in the market. Cost efficient production should be a concern in all parts of the production line.
- Differences in companies' cost structures. Relative differences in productivity among competing firms should lead to a situation where the most competitive firm wins contracts and is given opportunities to expand and evolve its production.
- Intermodal competition. The railway market should face the same external conditions as competing modes of transport
- Flexibility needed for adapting new traffic into the railway framework
- Non-discrimination of operators, freight -companies and passengers
- Clear information flows between operators and infrastructure managers to secure that decisions are made that are rational taking the whole railway system into account

Infrastructure charging is naturally advocated as an important tool to help fulfilling such requirements. Work Package 7 has identified six different motivations for **charging:**

i. Favour the best possible use of the network

Favour the best possible use of the network from the standpoint of the management of priorities in operation (routes/slots) and economic efficiency criteria (economic surplus for example) and non-discrimination. The efficient tariff that reaches an optimal use of infrastructure is the additional cost that the use of infrastructure per additional unit of transport imposes on society. It is the short run marginal cost. Such cost is attributed, in absence of scarcity of capacities, to the wear and tear of the tracks, the consumption of electricity for the traction, the costs of signal additional, the costs of management and administration additional (if truly marginal), congestion traffic (delays), accidents, noise, pollution and other externalities.

ii. Cover all or part of the operating and maintenance costs of the rail network.

This coverage may be achieved globally or conversely for each section of the network, and this may be in an identical or in a differentiated fashion. Fixing the price at the short run (or long run) marginal cost is sometimes insufficient to cover all the costs. In this case, the fees can be established in accordance to the Ramsey principle or to the multi-part tariff. These fees system can however introduce some distortions.

iii. Reflect the level of service provided to the carrier

Which is a reference to the quality of service provided

iv. Contribute to the costs of the developing the rail network making investment self-financing

Allows new investment in this sector.

v. Encourage the use of the rail transport in intermodal competition

Because of insufficient harmonisation of the conditions of intermodal competition (external costs, social costs), the fees system of rail infrastructure has to take into account the fees concerning the others concurrent transport services. A particular problem is the pricing of the road infrastructure, because the users of this infrastructure directly pay only a part of the costs assigned to their use. A solution consists to offer compensation to the users of the mode that implies low costs.

vi. Contribute to the balanced regional development

Through improving the accessibility of disadvantaged areas, for reasons of equity and solidarity.

It should be noticed that the appropriateness of each of these motivations should be carefully analysed.

Furthermore, whereas public IMs might be less proactive in terms of market development, these might further suffer from political control, possibly preventing a suitable rationale regarding efficient pricing. The demand for governmental surveillance and control should therefore deserve some thoughts, with the aim of fostering the efficiency of the infrastructure management. On the other hand, commercially oriented IMs may raise other obstacles for efficient provision of railway services.

The socio-economic success of any approaches on charging will depend on the efficiency of regulation and on the degree of competition between Railway Undertakers (RU).

Moreover, regulation has not only to ensure the discrimination-free access to path capacity at earlier stages of implementation but also the right incentives to the IM to realise static, qualitative and dynamic (investment) efficiency.

Also the concept of ***train paths*** related to capacity allocation is a critical factor in the provision of track access service. This is, on most corridors, a scarce commodity in regard to departure times, arrival times and transit times. Existing timetables favour the established rail operators with multiple train paths at times that suit their business and with preferential transits that minimise the number of crossing delays. New operators are left with train paths that do not meet commercial or operational needs, but still costing the same, sometimes even more than those of the major operators.

This places new entrants in disadvantageous positions in relation to existing rail operators, in particular if we think about one of the most promising market segments for rail represented by freight. Hence there is a clear and real need to rationalise train paths allocation along with suitable charging mechanisms, in order to provide a level playing field between the railway undertakers while promoting the railway as a true alternative to road concerning freight.

The ***quality of the infrastructure*** is also critical in valuation of the service being provided. The track condition is a key factor, as there are large sections of track that cannot accept the top speed of high-speed trains. These substandard track sections reduce the ability of the traffic planner to maximize the efficiency of train paths. This causes sub optimal transits and increases the operational costs of the railway undertaker.

Also the ***information systems*** *must* be developed coherently on a cross-border perspective, in order to provide real time information concerning trains running and must be accessible to the rail operators. Currently, a number of different systems are used in different states. There would be benefits from deciding on a single system and ensuring that the system provides the operational and commercial requirements for both the track authority/company and operators.

Charges should be set for each corridor to encourage fair **competition with road and aviation**. Rates should be published and held for a minimum 12-month period. The current practice in some states, of negotiating with individual operators on the annual fee and/ or the usage fee, provides an area of uncertainty for rail operators regarding the equity of the result. Large annual fees on some track sections create **barriers to entry** for new operators. **The rates and fees must be uniform, transparent and reflect the quality of train path provided.**

The network authority/ company IM should be required to provide a range of services at a level consistent with rates, transit times and quality of ride competitive with road. Documentation of agreements should be standardised to incorporate uniform elements for all rail operators.

The agreements will need to address the levels of performance of both parties. The issues of termination, insurance and cost retrieval need to be reviewed and brought up to commercial grounds. Requests for train paths and negotiations for agreements should be given time frames and standard procedures and documentation introduced to facilitate this process.

All in all, charging procedures should give the right incentives for total railway production, competition between operators and between railway transport and road and aviation transport. The following chapter shows how this can be achieved.

Finally, **International traffic** which is heavily dependent on national charging schemes, priority rules and bureaucracy should be supported by common principles and clear charging systems ensuring transparency, predictability and non-discrimination. SRMC-pricing in all countries is a relatively easy methodology that will meet these demands. Financial mark-ups to cover parts of investment costs to the infrastructure charges create a sub-optimal situation at a national level. In international traffic, the disadvantages of such systems are even more visible. Each national IM will have few incentives and will often miss the ability to see the impact of reducing international operators' surplus.

2.1.2 Charging principles

The core pricing principles discussed in this document together with consideration on the concept of slot allocation are the short run marginal cost (SRMC).

The short run marginal cost (SRMC) principle, measures the cost of increasing output when we regard the capital stock as fixed. Applied to rail infrastructure, the SRMC measures the cost of accommodating an additional train to the existing rail network.

The long run marginal cost (LRMC) measures the cost of increasing output when all inputs can be varied. Applied to rail infrastructure, it measures the cost of accommodating an additional train service over a time period when the capacity of the network can be increased or decreased, that is: the capital stock can be changed. Sometimes, another cost-measure is used: Long run average incremental cost (LRAIC), which is the average cost of accommodating trains over a time period. This is related to LRMC but diverges on the fact that LRAIC is an average measure related to an increase in the number of trains.

Although largely depending upon an effective information system, setting prices equal to short run marginal cost should encourage the most efficient use of the network. SRMC-pricing gives the operators the right prices to take into account the total costs that their services impose on society. If different SRMC are calculated for different train paths, SRMC-pricing will also secure the correct allocation of train services at the different paths. However, and besides the fact that these pricing principles may not be sufficient to distribute slots optimally between competing operators, other possible reasons to not follow the SRMC principle do exist:

1. Departures from SRMC-pricing for competing modes of transport. In this case it may be necessary to set the prices according to second-best pricing principles. The theory of second-best pricing says that prices should be adjusted in all relevant markets so that no substitution is caused by the deviation from SRMC in any competing market. Thus the relative prices are correct.

2. Public funding constraints. Obligations to raise a certain amount of money in order to finance the investments will in general demand prices above SRMC. LRMC-pricing is one such principle.

3. Official policies on rapid growth in the investment rate. In order to arrange for rapid growth in the railway sector, the public authorities may increase profitability in the sector by low or no charging or even some kind of subsidies.

4. Stabilisation of charges. Changes in the underlying cost elements are only implemented at a particular pace. In order to ensure some stability in the conditions of competition in the train operating market, there might be a need to gradually adjust the charges. This is just temporary deviations from SRMC-pricing.

There are probably situations where all of these arguments can justify departures from SRMC-pricing. But it should be clear that such a choice would lead to a sub optimal situation in terms of efficiency. Ramsey pricing is a way of minimize the deviance from optimal prices.

Charging the use of infrastructure must be considered as a way to provide the right incentives to operators when choosing their activity level. All use of rolling stock induces tear and wear, not only on the rolling stock itself, but on the infrastructure that is used. These costs should be clear for the operators through the charges that they must pay for their activity.

Work Package 7 in the IMPROVERAIL project recommends the following guidelines for infrastructure charging, slot allocation and harmonisation of charges:

- Infrastructure charging principles based on **short run marginal pricing** (SRMC). This method means that trains are charged per kilometre for the access to the railways. These charges should equal the costs borne by the infrastructure manager, by the other operators as well as by the rest of the society, in relation to the train's activity. Thus, external effects like accident costs and environmental costs are included. SRMC-pricing does not include investment costs. Cost elements that are included are tear

and wear (maintenance) of the infrastructure, other marginal costs of provision of infrastructure, delay costs/ congestion costs, environmental costs (pollution and noise) and accident costs.

- These cost elements may **vary both with type of rolling stock and for different parts of the railway network.**
- National valuations of these cost elements vary. **Variations in valuation** between countries are not regarded as a problem. Different charging practices in different states, is on the other hand a problem. This might lead to sub-optimal incentives of routing of trains etc. **Charges may vary but charging principles should not.**
- There is a real risk for too low activity and investments of all types if infrastructure charges are introduced. Using SRMC ensures that the traffic that is excluded is not socially profitable.
- There are some motivations for departing from SRMC. One is **"second-best pricing"**, and is derived directly from economic theory: "If prices in one specific market are different from price equal to (social) marginal cost, it is optimal to adjust prices for alternative goods so that the relative price ratios are kept equal to the optimal situation. In practice: If road transport or aviation transport pay only 50% of their total social marginal cost, so should the railways, in order to avoid a bias in favour of road and aviation. It can be argued that political biases in favour of railways might lead to subsidies of railways hidden in "second-best" arguments. The obvious solution to this is to let all modes of transport pay for their social marginal costs, thus making second best optimum equal to first-best.
- Another argument is the need for a **capital cost coverage factor** from the operators for the funding of infrastructure. This argument is reasonable in terms of allocation, but may lead to system inefficiency. The optimal capital cost coverage factor is therefore zero. If some contributions are essential, a lump-sum transfer is recommendable. Charging a "per-kilometre" contribution margin leads to less railway activity than what is optimal. Also competition might suffer if profitability of operators is affected. Politicians who see railways as a tool to increase the efficiency of the European transport system should therefore take note of this.
- **Tear and wear** of infrastructure caused by rolling stock should be calculated at a desirable level of accuracy. This is a major element of SRMC. There will always be a great number of variables that affect these costs, and there will always be some inaccuracy and uncertainty in the calculations. The effort that is spent on these calculations are justified if the value of fine-tuning the methodology is equal or above the costs of estimation. Varying charges for different train-types if the underlying cost structure is different is recommendable. A top-down approach with a limited number of parameters seems sufficient in most cases
- System costs as **congestion costs and scarcity costs** are difficult to assess and to charge for. The best way to calculate these costs is in **well functioning auctioning systems**. Probably the worst way of measuring these costs is by a dysfunctional auctioning system. Therefore, recommendations for methodology for calculations of these costs can only be done for a given railway system, assessing the level of competition, the ability to control cooperation etc. and the level of these costs. Some networks do not have very much congestion, while others are severely congested. Complexity of calculation methodology should reflect the potential benefits of these calculations.
- In regimes where well functioning auctioning system is unlikely, the congestion costs can be partly taken care of by either one or more **mark-ups for congested areas** in time and space, or **cost-benefit analysis** of different alternative timetabling solutions. The latter may be sufficient in very small networks only.
- **External effects** like environmental costs and accident costs should be based on calculations that ensure that costs induced by different modes of transport in each country are treated in the same manner. Otherwise the relative prices of the different transport modes are altered. The methodology of assessing these costs is developed continuously. Regular revisions of charges based on new information on the valuation of these costs are probably necessary.
- The way that the national railway systems are organised affects the way that charges are set and collected. The **regulative environment of the IM is greatly affecting the way that charges are set**

in order to secure the social optimum. Infrastructure charging is easier to implement in a regulatory environment where the IM does not need to be economically viable. An IM that can take the social optimum into account will be able to set the correct charges without much governmental control.

- When the IM is a self-financing entity running on commercial terms, the government must set the correct charges. Otherwise the IM will maximise own profit or revenues instead of securing the optimal railway activity. Thus the need for **governmental control and surveillance** of the railway sector increases when the IM is separated from public control. Even the detailed calculations of maintenance costs need then to be revised in order to secure that the costs are not exaggerated.
- A profit-maximising IM is especially difficult to handle in a situation where the IM or one or more operators get **public transfers**. Then, the system must be controlled in detail in order to avoid monopolistic behaviour from the IM.
- **Slot allocation procedures** mean everything from a round table designing the timetable to an advanced auctioning system for slots, bundles of slots etc. This deliverable explains opportunities that lies in auctioning procedures, but also describes many of the problems and pitfalls that such methodologies induce. A hasty introduction of such systems is therefore not recommended, because the efficiency of the timetabling procedures might be seen reduced instead of increased.
- **Auctioning systems for residual slots** may be a first step towards an auctioning system for the majority of slots in the future.
- Such advanced system is likely to function only in situations with **mature competitive railway markets**. Such a market should have multiple operators that are able to deliver the same type of services. In addition public transfers to railway units should be clearly visible. For example public transfers to bidders may destroy the competition altogether: Such contestants should stand on equal terms, so that the bids reflect their underlying and potential productivity and not their access to public money.
- Harmonization of charges should be secured by introducing the same charging methodology in all states. If costs are varying between states, charges should also vary between states. The charges of each line at all times of the day should be available for all parties upon request. Websites is a good alternative for letting international train operators gain immediate access in order to plan, register and price a specific train route. **Transparency** is thus a keyword in order to arrange for increased international traffic.
- Some **procedures for slot allocation** and infrastructure charging are presented. The procedures are meant as examples of how some problems can be taken care of within a relatively simple system, and not as ready-to-implement systems. The European railways are far too different and multi-faceted in terms of financial, political, economic and historical characteristics that one charging procedure will function everywhere.
- **Fair and non-discriminatory charging** is an absolute demand in order to develop competition in the railway operating market in the years to come
- There are good reasons for attempting to **harmonize national jurisdiction and regulatory environments**.
- Opening up for, and experiencing more **cross-border traffic**, passenger traffic as well as freight, will give us more information for what obstacles and problems are encountered in the different regulatory environments.
- The market will therefore **reveal costs and preferences**, so that in near future we will have more information for choosing among different regimes.
- There is a risk of **inefficient rerouting of trains** caused by different national charging practices. Only when the different charges are based on real internal and external costs in all countries, the market will act optimally.

- **The key word is not harmonisation alone, but transparency:** prices setting must be clear. Through a more developed international railway market with transparent regulation, financial flows and charging principles, the way that charging principles should be harmonised will be clearer.
- There is a risk for **welfare redistributions** between countries, where countries near the hubs in central-Europe may pay for wear and tear of traffic that are to the benefits for countries positioned further out of the centre. This is an argument against lump-sum pricing and in favour of kilometre-dependent charging.
- Charging principles must be complex enough to include the most important train types etc, but simple enough not to make the business decisions for the operators **unnecessary complex.**
- New entrants may face troubles to provide a feasible and competitive set of slots to their clients. The risk that **existing operators use market power** to take the best slots in order to avoid competition is real.
- Slots sold to competing operators, should be sold in some way that reflects the Willingness To Pay (**WTP)** of the operators.
- Public Service Obligations (PSOs) and stability for end-users suggests that the **timetables must be set for a reasonable period of time** - at least one year.
- On the other hand, too long timetabling periods will reduce the **pace of reformation** in the railway sector.
- Slots can include **quality variables**, where WTP should reveal the market preferences and valuation
- **RailNet Europe** is a promising tool in order to provide help to international traffic. Such an organ might be vital in providing transparency
- Infrastructure charging and slot allocation procedures can be performed within all present **regulatory regimes.** The way that the IM is functioning will strongly affect how the market will perform.
- Auctioning systems based on market mechanisms will not necessarily lead to better performance of the railway system. These methodologies demand **transparent public transfers** to railways as well as a real **competitive market for railway services**.

2.2 Data Requirements

In order to apply charging methodologies based on the effective knowledge of the costs associated to Infrastructure Management, it is necessary to have information systems available. Some systems are standard accounting systems, some are simulation systems and some are based on more or less regular studies carried out by accountants and consultants (cf. Appendix 1 as an example).

In addition to that, IMs are obliged to publish the key data based on their infrastructure management systems. Currently, most IMs are either using or in the process of implementing integrated information systems. Notably among these, it is SAP R/3 (and follow-ups) for internal data management, which could enable to build a common platform for effective data exchanges. However, the very different definitions of cost categories used in practise make it uneasy to get a harmonised input into cost data sources.

Such information systems allow keeping track on costs and the identification of relevant categories, including its allocation to activity levels to develop historic information in support of, e.g. maintenance and renewal decisions. Also the allocation of overhead costs currently follows different principles, which is an obstacle for the true assignment of costs. Again, it is necessary to reduce these costs to the minimum aggregation level in order to keep tight control over the costs which are driven by level of activity in order to fairly reflect those variations in the pricing principle applied, in particular regarding SRMC.

Different charging regimes are possible and different possibilities are presented in this report. To this end, we have seen that charging procedures depends (at least) on the following factors:

- Target function of the IM
- Connection between the government/ public authorities and the IM
- Connection between the government/ public authorities and the operator(s), and especially the successor of the previous integrated railway company
- Financial flows of public money to IMs and to operators in form of PSOs

This Deliverable 9 concludes on short run marginal cost pricing (SRMC) as the right basis for infrastructure charges, consisting of the following main elements:

- **Wear and tear** – Induced need for maintenance caused by a specific train using the infrastructure
- **Marginal costs related to signalling surveillance etc** – Extra costs of railway system administration should be included if these are truly marginal.
- **Accident costs** – One more train on track increases the accident risk for passengers, employees and third parties. These costs should be included
- **Environmental costs** – Emissions and noise pollution are the main elements in this cost category
- **Congestion costs** – Each train added to a given network will rise, to an increasing extent, the expected delays in the railway system. This is an externality posed by the operator to the others and should be internalised by a correct internalisation scheme.

Congestion costs have been found to be a rather difficult cost type to measure. We do recommend, as a start to use simple matrices where mark-ups varying with urbanity and time of day, shows the infrastructure charge of using the infrastructure at a special place at a certain time (slot). As an introduction, auctions for residual slots could be introduced.

Data requirements for short run marginal cost pricing

Work package 5 and work package 6 of IMPROVERAIL as well as several other research projects shows details on SRMC-elements. This deliverable shows instead which options exist, and produces recommendations for the European railways for the coming years.

Calculation of these cost elements needs detailed country-specific information of cost structures related to maintenance, accident risks and valuation of (avoidance) of such incidents. We recommend using country-specific cost values. Different wage levels, valuations, investment level and type lead to differences in SRMC. As a whole, the railway market may suffer if IMs are free to exploit market dominance to gain revenues from infrastructure charging. The responsible authorities must be able to apply suitable control on IMs, ensuring that the rules agreed upon are not undermined, notably those related to international and cross border traffic.

International traffic and SRMC

Whenever SRMC principle is not applied, the non-discrimination of railway operators must still be secured. In an international environment also the non-discrimination of IMs must be secured. This applies also to cross border contexts, since along any given corridor if one IM charges above SRMC, other IMs may

suffer a relative disadvantage. Prices above SRMC can be charged by demanding a contribution margin or by keeping the SRMC unnecessary high.

There is therefore a need for international surveillance of the IMs, to secure that market dominance is not subject to abuses.

Indeed, international traffic makes charging more complex. IMs can assume three different roles in the process of providing paths for international rail carriages:

- Origin IM,
- Transit country IM
- Destination country IM.

SRMC-based railway charges should be allocated to each of these IMs according to the SRMC-charges that apply for the different routes. Marginal congestion costs should of course also be included, and as a first adaptation, a mark-up matrix for city-areas and rush hours is recommended.

Again, the goal to make these costs visible for the operators before the actual journey is performed is vital for the transparency of the railway market.

Needs for a new regulatory environment to ensure fair charging practices internationally

In order to meet the demands stated in this section, two new international organs may be necessary. First, an unit that can perform *surveillance* over the charges set in all European countries should be able to reveal discriminatory behaviour or profit-seeking behaviour among infrastructure managers. This organ should be continuously active in order to avoid that discriminatory or other harmful behaviour can persist.

This organ should also keep an eye on timetabling procedures and other track allocation procedures, to ensure that these are performed within the prevailing regulatory framework.

Another organ may also be implemented: An *Information* organ keeping track of all charging procedures, track allocation procedures etc as well as the operators' data needed for assessing charges and be granted access to a specific piece of track.

These two organs are further described in section 7.5.

3 Introduction

3.1 Objectives

In contrast to road infrastructure, the physical inflexibility of railway vehicles makes it impossible to deal with track capacity shortages by way of queues dissolved in real time. Conversely, decisions about how to run trains are taken well before a service departs, and these timetabling decisions are typically valid for a considerable period of time, in Europe normally from one semester to one year. One task of the IM is therefore to decide which operators that have the right to run services over its infrastructure and on which departure times [Nilsson, 2000]. In return for the right to run services, each operator pays fees according to a pre-specified charging structure. European Commission (1998) provides a plan for how the Commission envisages the future of this system. The concentration of EU's policy is indeed on the open access; the purpose being to open up for the benefits of competition also within this traditionally closed market. Obviously, there is a need of establishing practicable ways to charge for scarce capacity and to allocate this capacity among the different users.

The principle of track access charging is easy to understand. For railways, the infrastructure is limited in each section to serve one or a few vehicles at the same time. The access to a sequence of sections of the infrastructure at a specific sequence of points in time is called a slot or a path. These two terms are used as synonyms in this deliverable. The operators have a different willingness to pay for different slots, varying with the underlying demand function of the passengers and the characteristics of the operators. For traffic running according to a timetable, real time pricing is impossible. The slot pricing must be done in advance during the setting of the timetable and must be based on demand-supply relationship. Supply is closely related to how the infrastructure is divided in blocks. Making the blocks shorter, possibly by improved control and signalling installations, which may reduce the distance between consecutive trains, can increase supply. Demand is derived from the underlying demand for passenger and freight transport. Generally, demand is varying strongly over the day, and this will make the value of different slots very different.

Given all these constraints, how should Infrastructure Managers deal effectively with this kind of problems, targeting economical optimisation based on an in-depth knowledge of cost elements related to infrastructure provision?

The central aims of this deliverable 9 is precisely to show that track capacity in the European railways may be allocated using economical tools for ensuring fair and efficient distribution, keeping a link to Data Requirements in terms of available elements of cost.

3.2 Structure of the Report

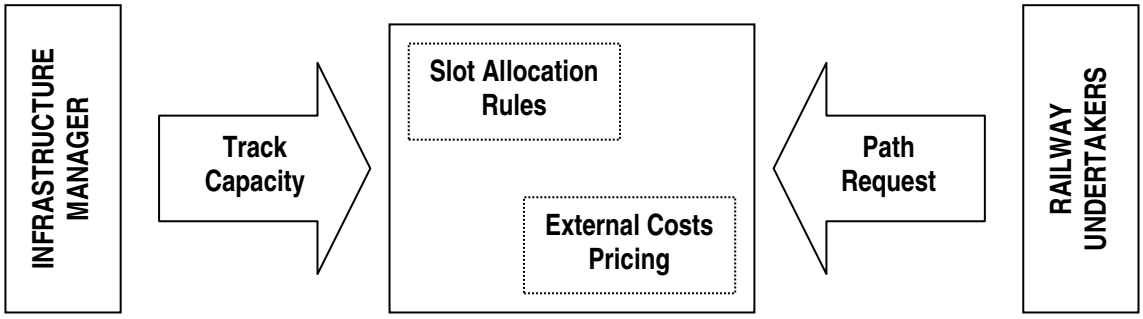
Chapter 1 - Technical information of the deliverable.
Chapter 2 - Summarises main findings of the research undertaken in Work Package 7 and presented in this deliverable.
Chapter 3 – Addresses an introduction to the topic, and a brief description of some of the main problems and issues that this report concerns. The chapter also includes the background to the railway revolution in Europe by describing the most important directives from the European Commission affecting the railways directly.
Chapter 4 - Is dedicated to describing infrastructure charging in theory and practice.
Chapters 5 and 6 – Here, slot allocation procedures are given a comprehensive discussion using theory and practices from railways as well as from the aviation sector.
Chapter 6 - Discusses problems underlying the introduction of infrastructure charging of different types, and possible ways of solving them are given.
Chapter 7 - Is dedicated to show a framework for charging of railways, where the need for harmonisation of national charges is emphasised.
Chapter 8 - Closes this deliverable, by developing key conclusions and producing recommendations

3.3 The Role of Slot Allocation in Infrastructure Charging Procedures

Figure 1 illustrates how both pricing principles and track allocation may be seen as complementary elements playing a crucial role in the relationship between the infrastructure manager and the railway undertakers or operators.

According to the suggested scheme, while the infrastructure manager is responsible for the track capacity, a separate body sets the allocation rules.

Figure 1: Connection between capacity management and operators' demand



As indicated in figure 1, a division between slot allocation rules and external cost pricing rules is considered as a basic condition for a successful discussion of slot allocation procedures.

The separation between **railway infrastructure charges principles**, (including the pricing principles of being granted access to the infrastructure) and **slot allocation pricing principles** (including which are the specific parts that relates to the price of being granted access to the track at a special section of the track at a particular time) should be made clear.

In the case of a monopolistic railway system, the latter pricing principle is needless, but in the case of a multi-operator railway system, a fair and efficient slot allocation procedure becomes absolutely necessary.

Such separation is upheld throughout this paper. Environmental costs, accident costs, tear and wear of the infrastructure as well as delay costs are related to the first type of charging. The slot allocation charges are set to distribute the network capacity among operators, when there is more than one operator seeking slots in a special area at any given moment.

3.4 The Impact of EU Directives on Railway Infrastructure Management and Charging

3.4.1 Glossary

In order to deal with track capacity allocation problem properly, basic definitions must be set down. Below are summarised some of the most common used terms regarding track capacity allocation.

"Basic Interval" timetable	The sequence of trains with identical characteristics, running at constant intervals up to two hours.
Capacity	The potential to schedule train paths requested for an element of infrastructure for a certain period; in other words it is the total of the train-paths, constituting the global potentiality of use of certain parts of railway infrastructure.
Capacity allocation	The allocation of infrastructure railway capacity by the entrusted Body.
Charge	The price to be paid by TOCs for use of each path.
Contract for the railway	The legal act granting each TOC the use of railway
Corridors	Major railway lines on a geographical route
Cross links	A national or international train-path connecting two existing corridors.
"Headway interconnection system"	Correspondence train-sequence with identical waiting-time between basic interval trains.
Infrastructure Manager (IM)	Any public body or undertaking responsible in particular for establishing and maintaining railway infrastructure, as well as for operating the control and safety systems,
Interchange-station	Border station where transit operations are carried out.
International Grouping	Any association of at least two railway undertakings established in different Member States for the purpose of providing international transport services between Member States.
Licence/Entitling act	Licence, issued by the competent national body in compliance with Dir. 2001/13/CE
Operator(s)	Train-operating company (-ies), TOC(s)
Path	The infrastructure capacity needed to run a train between two places over a given time-period; Also referred to as a slot.
PSO	Public service obligation, The Government or other public unit purchases services that else would not be offered.
Railway Undertaking (R.U.)	Any private or public undertaking whose main business is to provide rail transport services for goods and/or passengers

	with a requirement that the undertaking should ensure traction. Also designated as "Operator", "TOC"
Reservation fee	The price to be paid by the R.U. for the reservation of train paths in compliance with the criteria and operating procedures for capacity allocation
Safety Certificate	The document certifying the R.U.'s compliance with circulation safety standards as required by CE Directives.
Slot	The infrastructure capacity needed to run a train between two places over a given time-period; Also referred to as a path.
Timetable	The data defining all planned train and rolling-stock movements, which will take place on the relevant infrastructure during the period for which it is in force.
TOC	Train-operating company, operator

3.4.2 Railway Infrastructure's Organisational Framework

The European directives 91/440, 95/18, 95/19, have defined current responsibilities of the infrastructure manager. The directives 2001/12, 2001/13, 2001/14 and further amendments have been defining the future responsibilities of the infrastructure manager. In addition to these general European standards, national regulations form the basis for the national railway systems.

In this context, European directives are gradually becoming more and more specific and thereby flattening discrepancies in terms of regulations and practices in Member States.

The directive 91/440/EEC defined the **infrastructure manager** as "any public body or undertaking responsible in particular for establishing and maintaining railway infrastructure, as well as for operating the control and safety systems". The directive 95/19/EEC adopts the same definition for the infrastructure manager.

The directive 95/18/EEC defined the **licensing authority** as "the body charged by a Member State with the issue of licenses". Nevertheless, this directive does not specify that the licensing authority is the infrastructure manager.

Moreover the directive 95/19/EEC considers also the existence of an **allocation body** defined as "the authority *and/or* infrastructure manager designated by the Member States for the allocation of infrastructure capacity". But, in other words, the infrastructure manager is not inevitably the allocation body of the of railway infrastructure capacity.

Organization and Accounts

Two possibilities for the organization of the infrastructure manager exist. According to these, the infrastructure manager can either be a distinct division within a single railway undertaking or the infrastructure manager can be a separate entity.

The accounts for the management of railway operation and infrastructure and for the provision of railway transport services are nevertheless kept separate, while no transfer of financial aid between the two areas of activity are allowed.

If the infrastructure manager is the allocation body, he shall ensure a fair and non-discriminatory allocation of the railway infrastructure capacity and an optimum effective use of the infrastructure.

From the text of the EC Directives:

"The accounts of an infrastructure manager shall, under normal business conditions over a reasonable time period, at least balance income from infrastructure fees plus State contributions on the one hand and infrastructure expenditure on the other".

"The infrastructure manager may finance infrastructure development including provision or renewal of capital assets, and may make a return on capital employed".

In case of infrastructure capacity allocation in the interests of public service, decided by the State member, the infrastructure manager may have compensation by the State member for any financial losses. The infrastructure manager may therefore benefit from Member States financial aid if consistent with the tasks, size and financial requirements, in particular regarding new investments.

Charging

A fee for the use of the railway infrastructure is charged, payable by railway undertakings and international groupings using that infrastructure. The rules for determining this fee are defined by Member States after consulting the Infrastructure Manager. The directive 95/19/EEC add that these rules may allow for the marketing of the available infrastructure capacity "*efficiently".*

According to the directive 91/440/EEC, the user fee, which shall be calculated in such a way as to avoid any discrimination between railway undertakings, may in particular take into account the mileage, the composition of the train and any specific requirements in terms of such factors as speed, axle load and the degree or period of utilization of the infrastructure. The directive 95/19/EEC is more general and consider that the fees shall be fixed according to "the nature of the service, the time of the service, the market situation and the type and degree of wear and tear of the infrastructure".

Information on the determination of the fees and on modification of the infrastructure quality and capacity shall provide by the infrastructure manager to the State member and to the railway undertaking.

Access to the Infrastructure

The directive 95/18/EEC considers the allocation of license for railway undertaking defined as "authorization issued by a Member State to an undertaking, by which its capacity as a railway undertaking is recognised".

The license is necessary to provide the rail transport services. However, "such a license shall not itself entitle the holder to access to the railway infrastructure". A licensing authority should issue such licenses, which is designated by each Member State. Nevertheless, the directive doesn't specify whether the licensing authority may coincide with the Infrastructure Manager (IM) itself.

The licensing authorities of the Member State should ensure and control, prior to the start of activities, that railways undertaking will be able to meet the requirements relating to good repute, financial fitness, professional competence and cover for its civil liability. These requirements are defined for the state member and for the licensing authority. If a railway undertaking can no longer meet the requirements of the Directive, the licensing authority shall suspend or revoke the license.

It is interesting to note that the directive 95/19/EEC does not mention the licensing authority introduced in the previous directive and considers only the infrastructure manager and an "allocation body".

The infrastructure manager concludes with railway undertakings engaged in international combined transport of goods and international groupings the necessary administrative, technical and financial agreements.

The directive 95/19/EEC gives more details on the allocation procedure compared to the directive 91/440. The railway undertaking submits an application or request for infrastructure capacity to the infrastructure manager, should this be also the allocation body.

A decision is taken on the request as soon as possible, but no later than two months after all relevant information has been submitted. The railway undertaker has then to obtain a valid safety certificate relating to "the technical and operational requirements specific to rail services and the safety requirements applying to staff, rolling stock and the undertaking's internal organization". The traffic rules are those "applied" by the infrastructure manager. The directive 95/19/EC indicates that the safety certificate is issued "by the authority designated for the purpose by the Member State". But the infrastructure manager is not inevitably this authority.

In the event of problem arising regarding allocation of infrastructure capacity or the charging of fees, the Member States have to implement an independent appealing body.

3.4.3 The "Railway Package"

The directives 2001/12/EEC, 2001/13/EEC and 2001/14/EEC amend respectively the Council Directives 91/440/EEC, 95/18/EEC and 95/19/EEC. Nevertheless they are in the continuity of the first directives.

These recent directives introduce new arrangements and provisions in the previous directives and give further information on the rules and actors. **The directives aim to prevent the confusion of the functions between the actors (State, infrastructure manager, railway undertakings, regulatory body, applicants).** In particular, the directives consider the case where the functions of the infrastructure manager on a network or part of a network may be allocated to different bodies or undertakings. Moreover they have as goal the increase of open access and the organisation of competitive market across the European Railway system.

As for the previous directives, the analysis is focused on the infrastructure management. Others points linked to this question are also mentioned.

In the directive 2001/12/EEC, the **infrastructure manager** is defined more precisely compared to the definition of the Directive 91/440/EEC. The infrastructure manager is "any body or undertaking responsible in particular for establishing and maintaining railway infrastructure". But the responsibility of the management of infrastructure control and safety systems by the infrastructure manager is merely a possibility and not an obligation. In other words, the EC Directive considers that a distinct body may undertake these activities. Moreover the infrastructure manager functions may be allocated to different bodies. This possibility of decomposition for the infrastructure manager is not spelt out in the previous directives but the latter distinguished already "infrastructure manager", "allocation body" and "licensing authority".

The directive 2001/14/EEC introduced a new notion with "**applicant**". Applicant is defined as "a licensed railway undertaking and/or an international grouping of railway undertakings, and, in Member States which provide for such a possibility, other persons and/or legal entities with public service or commercial interest in procuring infrastructure capacity, such as public authorities under Regulation (EEC) No 1191/69(12) and shippers, freight forwarders and combined transport operators, for the operation of railway service on their respective territories.

Organization and Accounts

An effort is demanded to ensure that separate accountings and balance sheets are kept and published, for business relating to the provision of transport services by railway undertakings and, also for business relating to the management of railway infrastructure.

The infrastructure manager has to balance "income from infrastructure charges, surpluses from other commercial activities and State funding on the one hand, and infrastructure expenditure on the other" and reduce the costs of provision of infrastructure and the level of access charges "with due regard to safety and to maintaining and improving the quality of the infrastructure service".

The infrastructure manager has to draw up a "**business plan including investment and financial programs**" within the framework of general policy fixed by the State. The plan shall be designed to ensure optimal and efficient use and development of the infrastructure while ensuring financial balance and providing means for these objectives to be achieved.

As before, the infrastructure manager may benefit from Member states financing. But to ensure the financial sustainability the resources of the Infrastructure Manager granted by the Member States is implemented through a contractual agreement covering a period of at least three years.

Charging

As one of the key aspects addressed in this document, the directive 2001/14/EEC which is focused on charging aspects, has basically the same principles of charging as defined previously. The infrastructure charging schemes have to encourage in particular the infrastructure manager to minimise disruption and improve the performance of the railway network.

While respecting the management independence, the specific charging rules are established by the state member or the infrastructure manager. As considered in the directive 91/440/EEC, the infrastructure manager determines and collects the charge for the use of infrastructure except if the infrastructure manager is not independent in its legal form, organization and decision-making from any railway undertaking.

The charging is relating to four packages of services described precisely by the directive 2001/14/EEC: the minimum access package, track access to services facilities and supply of services, additional services and finally, ancillary services.

- For the minimum access package and for the track access to services facilities and supply of services, the principle of charging seems to be the marginal cost. Indeed, the charge is set at "the cost that is directly incurred as a result of operating the train service".
- For the additional services and the ancillary services the principle of charging seems to be the full cost. In effect, if these two kind of services are provided by one supplier, the charge imposed for such a service shall relate to the cost of providing it, calculated on the basis of the actual level of use

Nevertheless, the infrastructure manager may introduce additional charges and exceptions and discounts in the infrastructure charge. Two types of additional charges may include:

- Charge of scarcity for "the identifiable segment of the infrastructure during periods of congestion".
- Charge for the cost of the environmental effects caused by the operation of the train. The additional charge, function of the magnitude of the effect caused, is conditioned by the implementation of such charging at a comparable level to competing modes of transport.

Two exceptions for these charging principles are considered:

- For "specific investment projects, in the future, or that have been completed not more than 15 years before the entry into force of this Directive", the charging is based on the long-term costs of such projects.

- The infrastructure manager may adopt full cost charges and not marginal cost charges, " if the market can bear this".

Discounts are introduced in particular "for specified traffic flows", to "encourage the development of new rail services" or the use of "considerably under-utilised lines".

Allocation and Access to the Infrastructure

For the allocation of capacity in the form of a train path to applicants, the directive adopts the following rule:

- The infrastructure manager or the allocation body – if the infrastructure manager is not independent in its legal form, organization or decision-making functions of any railway undertaking - has to be equitable and non discriminatory with all applicants concerning the allocation of capacity.
- The proceedings for the allocation of capacity have to be transparent. All the necessary information should be published in advance.
- The commercial confidentiality of information provided to the infrastructure managers and the allocation bodies have to be respected.

Then the implementation of these principles leads to the definition of obligation for the infrastructure manager. In particular the infrastructure manager or the allocation body have to produce for the applicants a "**network statement**" given details on general rules, deadlines, procedures and criteria concerning the charging and capacity allocation schemes.

The infrastructure manager or the allocation body settles with the accepted applicant a "**framework agreement**", which becomes a legally binding general agreement on the basis of public or private law, setting out the rights and obligations of each partner in relation to the infrastructure capacity to be allocated and the charges to be levied over a period, necessarily longer than one working timetable period.

The infrastructure manager shall, as far as possible, meet all infrastructure capacity requests including those for train paths crossing more than one network, and shall as far as possible take account of all constraints on applicants, including the economic effect on their business. The infrastructure manager shall consult interested parties about the draft-working timetable and allow them at least one month to present their views. In this case, the infrastructure manager makes an effort to coordinate all requests.

If a section of infrastructure is congested, as demand for infrastructure capacity cannot be fully satisfied during certain periods, the infrastructure manager should develop a "capacity enhancement plan" defined as a measure or series of measures with a calendar for their implementation which are proposed to alleviate the capacity constraints.

In the event of dispute relating to the allocation of infrastructure capacity, a dispute resolution system shall be made available in order to resolve it.

For a congested infrastructure section, some priority criteria to allocate infrastructure capacity are defined. These criteria are relating the importance of a service to society (public service, rail freight), relative to any other service. The Member State shall grant the infrastructure manager compensation corresponding to loss induced by theses services.

For the open access to the network, the directive considers that all the railway undertakings shall be granted the access to the Trans-European Rail Freight Network defined in Article 10(a) and in Annex I. and to the entire rail network after the 15th of March 2008, for the purpose of operating international freight services. This means that the open access is not restricted to some type of railways undertakings. Only the international freight businesses are affected and not the passenger traffic and the cabotage. According to this, only the tracks of the TERFN will be truly open to competition.

To control the open access, the directive 2001/14/EEC extols the existence of a "**regulatory body"**. It can be the Ministry responsible for transport matters or any other body. This regulatory body shall be independent in its organization, funding decisions, legal structure and decision-making from any infrastructure manager, charging body, allocation body or applicant.

Proceedings are developed with this "regulatory body". Any applicant can lodge a complaint with this body if it feels that it has been treated unjustly or, has been the subject of discrimination or has been injured in any other way. This regulatory body shall decide at the earliest opportunity on appropriate measures to correct undesirable developments in these markets. Directives 2001/12/EEC and 2001/14/EEC admit some exceptions in the implementation of this independent body to ensure equitable and non-discriminatory access to infrastructure. Ireland, United Kingdom for North Ireland, Greece as islands with a rail link to only one other Member State or without direct rail link to any other Member State can postpone this implementation for a period of five years from 15 March 2003.

The previous directives 91/440/EEC, 95/18/EEC and 95/19/EEC were not sufficiently accurate. In their application at the national level in many cases, there is confusion between the railway actors, in particular for the infrastructure manager functions. In fact the infrastructure manager is not a body independent in its organization, funding decisions, legal structure and decision from railways undertakings. Moreover, the infrastructure managers with the support of the railway undertaking sharply limit the open access and competition. In order to stimulate more the European railways system, Directives 2001/12/EEC, 2001/13/EEC and 2001/14/EEC clarify the principles and rules for each actor in particular for the infrastructure manager. They define a lot of responsibilities for the infrastructure manager. They consider also a **situation with not a monolithic infrastructure manager but with different bodies** for the allocation of railway capacity, the allocation of licenses, the control of the safety, and the control of the implementation of the equitable and non-discriminatory charging and allocation principles.

4 Overview of Infrastructure Charging

4.1 Background

A decade ago, the implementation of the rail infrastructure-charging concept in Europe was limited to Sweden. European Railways were typically state-owned vertically integrated companies. The question of infrastructure charging was thus irrelevant for most European countries.

Since then, the continued declining of Railway in favour of other modes, have brought this subject to light in view of the necessary improvement in its efficiency, seen today as a basic requirement for the sustainability of railway. Based upon economic theory, several documents related to this subject have been emphasising that introducing innovative pricing instruments may be the right approach.

Notably among these is the Green Paper of the European Commission, published in 1995', entitled "Toward Fair and Efficient Pricing" clearly stating that accidents, congestion, environmental cost and infrastructure maintenance costs weren't correctly reflected in the prices underlying the use of transports in general.

With a basic argument on the marginal social cost pricing, and whilst allowing non discriminatory fixed charged to be levied where this is not adequate for full cost recovery, the Commission has since published its proposals for a common transport infrastructure charging (see "Fair payment for infrastructure use: a phased approach to a common transport infrastructure charging framework in the EU", 1998). *"Within the railway package rules have been agreed for infrastructure charging which are based on marginal social cost, but where non-discriminatory supplements may be added to meet budgetary needs"* (Nash and *al.*, p.9, 2001). The Commission sees this as an important way of improving the efficiency and marketing of rail transport and, hence, of increasing the role of railways in Europe.

European Directive 91/440 introduced the possibility of infrastructure charging with the accounting separation between train operations and infrastructure provision.

Therefore, explicit methods of charging for the use of rail infrastructure are needed. They are keen to see comparable approaches to infrastructure charging being used in all member states, to avoid the distortions that exist when neighbouring countries charge for the use of infrastructure on a totally different basis. However, deriving and implementing an appropriate pricing system poses extreme difficulties. This deliverable will point out some guidelines for further harmonisation of national charging systems, and the different possibilities that lies in various systems.

4.2 The theory of rail infrastructure charges

4.2.1 Objectives of railway infrastructure charging

Before explaining the economic characteristics of railway and his basic pricing principles, we must specify the objectives of railways infrastructure charging.

Infrastructure charging provides a valuable instrument to the policy maker. Indeed, several objectives can be pursued. But since some of them are contradictory, a clear hierarchy has to be established. Otherwise, some forms of decay can follow: congestion and delays, over- or under-investments, poor maintenance and so forth. A short list of the possible objectives of railways infrastructure pricing is hereby presented (Quinet 1990, NERA 1998, RFF 1998, Nash and *al.* 1999).

1. **Favour the best possible use of the rail network** from the standpoints of the management of priorities in operation (routes/slots) and economic efficiency criteria (economic surplus for

example) and non-discrimination. The efficient tariff that reaches an optimal use of infrastructure is the additional cost that the use of infrastructure per additional unit of transport imposes on society. It is the short run marginal cost. These costs are attributed, in absence of scarcity of capacities, to the wear and tear of the tracks, the consumption of electricity for the traction, the costs of signal additional, the costs of management and administration additional (if truly marginal), congestion traffic (delays), accidents, noise, pollution and other externalities.

2. **Cover all or part of the operating and maintenance costs of the rail network.** This coverage may be achieved globally, or on the contrary for each section of the network, and this may be in identical or differentiated fashion. Setting the price at the short run marginal cost is insufficient to cover all costs that relates to infrastructure. In this case, the additional fees can be established in accordance to the Ramsey principle or to some multi-part tariff. These fee systems will introduce some distortions, but Ramsey-pricing will minimize the deadweight losses that the increased charges incur.

3. **Reflect the level of service provided to the carrier; service quality.** A typical quality variable that is in the hands of the IM is the length of the time interval for which a train can run. Increasing the length of this path in terms of minutes, reduces the risk for a train to be delayed because of other incidents on the track ,and the possibility for avoid large delays if the departure is falling a couple of minutes behind.

4. **Contribute to the costs of developing the rail network making investment fully or partly self-financing** This can be done by some kind of LTIC (Long-term incremental cost-function) or simply by one or more additive charges to the general infrastructure charges.

5. **Encourage the use of the rail transport in intermodal competition**, because of the insufficient harmonisation of the conditions of intermodal competition (external costs, social costs). The fee system of rail infrastructure has to take into account the fees concerning other competing transport services. A particular problem is the pricing of the road infrastructure, because the users of roads generally directly pay only a part of the costs assigned to their use.

6. **Contribute to the balanced regional development**, through improving the accessibility of disadvantaged areas, for reasons of equity and solidarity. Earmarked public transfers, or regional levels of charges etc will in general follow such public objectives.

All of these objectives cannot be adopted simultaneously, and any pricing policy will have to reflect the ranking of objectives established in the compromise accepted. Each option decided upon must be able to be evaluated from the standpoint of efficiency on the one hand and equity on the other.

4.2.2 The economics of railways

The specific economic characteristics of the railway industry are essentially focused on three points:

- The rail sector can be described as having a natural monopoly situation
- Rail sector exhibits also some features of both private goods and public goods
- As in the rest of the transport sector, rail is submited to externalities

Natural monopoly:

Economies of scale, scope and density are caused by numerous indivisibilities, including investment and functional indivisibilities such as co-ordination of activities between upstream and downstream of production (ECMT, 1998). As widely recognised, the railways sector appears to be a typical example of natural monopoly where the market mechanism does not lead to the best allocation of resources.

If a single firm produces the entire industry output and the total costs of production are lower than when such output results from any collection of two, an industry is said to be a natural monopoly. The sub-additivity of a representative firm's cost function is the first step of a natural monopoly. The second one is the existence of long-run economies of scale. *"If all prospective firms in industry have the same cost function, or if one firm has a uniformly better technology, then subadditivity implies that industry costs are minimized if only one firm is active in the market"* (Sharkey, p.604, 1987).

Private and public good

Rail sector exhibits also some features of both private goods and public goods. With private goods the consumption possibilities of one individual depend on the quantities consumed by others, with the public goods the situation is different. Given the supply of the good, this type of goods referred to as non-rivalry in consumption. Rail infrastructure constitutes a quasi perfectly excludable good but there is, to a certain extent a non-rivalry in consumption. In effect, the consumption of a slot might cause a delay for other trains and not exclusion. It follows that, in a sense, there is an indivisible quality for rail: the degree of congestion, and other characteristics frequently associated to congestion: punctuality and reliability.

Externalities

Externalities like congestion, environmental costs, safety and network externalities give even more room for potential market failures. Together these facts can explain the role played by the national governments in Europe: There is a need for public decision making in the railway sector and more widely in the transport sector.

Congestion

On roads, congestion usually manifests itself as volumes of traffic such that speeds are reduced below free-flow speed and/or queuing occurs at junctions. Congestion is one of the few examples of externalities where the agent causing also suffers from it (ECMT 1998). Rail congestion manifests itself in a different way. It is explained by the fact that rail infrastructure managers control access to the network on a planned basis. Nash (2001) distinguishes two effects of shortages of capacity: congestion and scarcity.

Congestion represents the expected delays that occur through the transmission of delays from one train to another. These become worse at high levels of capacity utilisation. Indeed, in this situation, there is a lack of disposable capacity to recover from any delays. Congestion costs are the costs associated with these

expected delays. Moreover if a train operator imposes with one of its trains a delay to another of its own trains, the external effect is, in fact purely internal. This might be a tricky point regarding congestion pricing.

Scarcity represents the impossibility for an operator to obtain the desired slot in terms of departure time, stopping pattern or speed. Scarcity costs is the value of shifting the timetable of any train that could not be run as a result of lack of capacity (opportunity costs).

The High Level Group on Transport Infrastructure Pricing identified scarcity rather than congestion as the dominant consequence of existing capacity constraints on the existing rail network (European Commission, 1999).

Environmental costs

Environmental costs are the impacts of local and regional pollution, global warming and noise emitted by railways.

Safety

When travellers use a rail service, they expose themselves to the average accident risk for all other rail users. Part of the costs of accidents may be not recovered from the rail company or its insurers. The economic value of these consequences of additional rail use form the marginal accident cost. The users, in their decision to travel by rail, internalise the risk they expose themselves to, valued as the willingness-to-pay for safety on the part of the households which they belong; they may, or may not, also take the willingness-to-pay for safety on the part of their relatives and friends into account their decision. Given those characteristics of rail sector, very briefly summarized, we will now address the question of the pricing principle.

Pricing principles

“For efficient use of infrastructure, in the absence of capacity constraints, operators willing to pay the extra costs they impose by their use of the infrastructure should be allowed to use it. Where there are capacity constraints, efficient use of the infrastructure is ensured when the capacity is allocated to the operator and type of traffic for which it has the most value” (Nash and al., p.3, 2001).

This conception of efficiency is built on a specific context: the objective of improving the existing capacity because the hypothesis is the absence of capacity constraint.

But as the objectives can be few and divergent (2 - 1), the specific context can change too. In this way, the pricing principle can differ.

4.2.3 Applicable Pricing Principles

Short Run Marginal Cost

The Short Run Marginal Cost (SRMC) refers to the costs of additional journeys when the capital stock remains constant. The SRMC includes additional congestion, environmental and safety implications of handling more traffic with the existing infrastructure, but will exclude all capital costs of infrastructure and any externalities concerned with the provision of capacity.

It is generally agreed that the Short Run Marginal Cost (hereafter SRMC) constitutes the best theoretical solution to the question of railways infrastructure charging (goal 1). The principle is rather simple. SRMC allows running all trains for which the additional costs borne by the society are inferior to the utility for the society. Even if the principle is simple, the question of what kind of costs have to enter in the SRMC is rather tricky. In particular, environmental costs and congestion costs lead to specific problems.

If environmental costs are included in SRMC for railways and, for example, not or not enough for road trucking, this might lead to an undesirable competitive distortion, precisely causing what the decision maker wants to avoid: a pollution increase. Taking into account the accident costs exhibits the same conflicting alternative (goal 2).

Per se, the congestion costs which can be further decomposed in delays and eviction are difficult to evaluate: what is the value of a delay for a particular train and what is the value of not running a train? Moreover, the congestion costs might be borne, at least partly by the trains of the operator causing the congestion. In that case the operator is bearing the congestion cost twice. The theoretical solution is to give back the amount of the charges that is due to delays or eviction of trains belonging to the same operator. But this might be the source of cumbersome calculation, sometimes rather arbitrary.

Short-run marginal costs represent how the infrastructure costs change in the short-run when rail traffic levels change. The requirement for efficient pricing is to ensure that the costs borne by the user of the infrastructure reflect the sum of the marginal costs of the infrastructure provider, the infrastructure user and the others outside the transport system concerned (goal 3).

The marginal costs to the infrastructure provider in the short run are mainly the costs of wear and tear (as well as any additional costs of traffic control or signalling). The marginal costs to users include the costs borne by the individual user taking the decision but also imposed on others users by increased congestion or accident risk.

Costs imported on the outsider of the transport system are predominantly external accident and environmental costs. The price relevant marginal cost is thus the sum of these marginal costs less the costs in any case borne by the individual user.

The variations in infrastructure cost with traffic levels are the short-run variable charges. They comprise several elements like track usage charges, traction current charges, peak charges, etc (goal 1).

The track usage charges are designed to recover the direct maintenance costs of the usage of the infrastructure for the wear and tear caused by individual trains running over a particular type of track. Indeed, if the number of trains or the weight of one or more trains increases, this can increase track wear-and-tear, and hence the maintenance expenditures necessary to keep track quality standards at a given level. Their costs reflect the type of locomotive, the speed, the type and composition of the train, and the service pattern. They are based on prediction about the impact on short-run incremental cost of marginal increases in the number of trains of a given type run of the network. The traction current charges are the costs of electricity for traction purposes.

An increase in the number of trains might e.g. increase signal operation costs. For example, in an old-fashioned mechanical signal box, the number of individual lever movements will increase as the number of trains increases. There will be administrative costs in running additional trains.

The long run marginal cost pricing principle (LRMC)

The concept of short run marginal cost is often contrasted with that long run marginal cost, which represents the additional cost of an extra train when the infrastructure is optimally adapted to the demand in question. The general perception that short run marginal cost is below long run is only true in the presence of excess capacity; the reverse is true when capacity is scarce.

LRMC is defined as the cost of an additional train when the infrastructure is optimally adapted to the demand (goal 1). Another approach, comparable to a certain extent, is simply to charge the long run average incremental cost of expanding capacity where the capacity is scarce (goal 4). The main difficulty with those approaches is to practically calculate the amount to be charged. Increasing the capacity of an infrastructure segment leads to the question of indivisibilities. Thus, the cost might vary considerably from place to place. To the contrary this charging system leads to charges more stable over time and thus facilitate the establishment of contracts between operators and infrastructure managers (Nash and *al.*, 1999). Long stable contracts may justify specific investments such as rolling stock. So, there are some

arguments in favour of long run marginal cost pricing, even if it would deprive the public of a valuable services (the services with prices between short run marginal cost and long run marginal cost). But, one of the major drawbacks of marginal costs (short run or long run) stems from the fact that railways are experiencing economies of scope, densities or scale. For that reason, marginal cost pricing doesn't fully cover the costs (goal 2).

A solution for this is the use of direct contributions from the State. However, this may be seen as dangerous practice, in terms of the incentives to efficiency; others fear that might prove inadequate to fund an appropriate level of investment. Moreover, the way to allocate the full cost of railways activity between services is often based on arbitrary criteria as we have seen in WP6 (Lifecycle Costs). Thus, to cover the non-allocated parts of the full costs some public findings might be needed. They are not given for free or, in other terms, there is a cost to get some public funds. So, other pricing methods might be used in order to adjust the level of public subsidies at the desired target level.

Long-run marginal costs (LRMC) represent the additional costs of providing an additional unit of traffic, under the condition that the level of infrastructure can be adjusted. We can distinguish long-run incremental costs, where the LRICs are the additional capacity and other costs of handling an extra block of traffic. These LRICs can be expressed in unit terms as long-run average incremental costs that are equal to the LRICs averaged over the extra units of traffic handled by the additional capacity. Precisely, this element of access charge represents the long run cost of maintaining and renewing the railway infrastructure. The density of train operations over a particular part of the network is a significant factor in ascertaining the relative importance of this element within the total track access charge. (Cole and Holvad, 1999).

SRMC versus LRMC

"In practice, indivisibilities and the time lags involved in adapting infrastructure to volume mean that differences between short and long run marginal cost are likely. This has resulted in a vigorous debate regarding the relative merits of short and long run marginal cost pricing (hereafter SRMC and LRMC)" *(Nash and* al.*, p.5, 2001).*

The long run marginal cost pricing approach can be argued for when there is a known need for specific infrastructure investments needed. In this case, the long run approach gives a more stable value over time, as e.g. the congestion charge is internalised. Linked to this is the fact that most of the European operators had negotiated contracts for a number of years, so they can justify specific investments in rolling stock or fixed equipment such as terminals. For Nash and *al.* (p.5, 2001), *"one solution might be to charge long term contracts on the basis of long run marginal cost, but to sell paths on the spot market at short run marginal cost".*

The short run marginal cost pricing does a favour for the commercial rail infrastructure company, which under constrained capacity increases their prices instead of investing in expansion. At least, if it is regulated to charge long run marginal cost this incentive is taken away.

Multi-Part Charging

The multi part charging consists of a tariff with one fixed part and one or several variable parts, linked to the quantity consumed (by example train mileage).

It is therefore possible to cover at least two objectives:

- Cover up variable cost near the marginal cost (goal 1), ensuring that the trains will be allowed to use the infrastructure to a degree commensurate to their social utility
- Cover up fixed cost, which is set according to a cost recovery target (goal 2).

This should allow to better manage running trains. Still, train paths for which the "willingness to pay" is only slightly bigger than marginal cost have fixed costs being paid implicitly by other trains, for which the train paths are more valued.

Hence, it is possible to propose a set of multi parts tariffs, with different weights for fixed and variable costs. When doing their options, larger operators will choose the tariff with higher fixed costs and lower variable cost. Conversely, smaller operators will tend to choose the tariff with low fixed cost and larger variable cost.

By means of a suitable design of tariffs it will be therefore possible to make the users of the infrastructure pay a bigger part of the surplus than with a single charging system (Barritaud, 2001).

Unlike that, in a single-part pricing system based on marginal costs, the condition that total cost must be covered can be obtained with an additional charge, incorporated into the single price. This additional charge may be linear, regressive or progressive for the user or be based on the operator's willingness to pay (e.g. Ramsey Pricing). The charges can be differentiated according to the type of traffic; suburban passenger, mainline passenger, freight traffic (goal 1). Furthermore, a difference can be made according to the time slot, the route and punctuality requirements (goal 3).

A two or multi-part pricing system might separate the additional charges and the marginal costs. These additional charges can take account of:

- Speeds (defined according to optimal capacity utilisation);
- Capacity situations on heavily used segments and at certain times (peak load pricing);

This additional charge can be a fixed time-dependent contribution or might be linked to demand characteristics (e.g. high-speed traffic, regional traffic, combined traffic, etc.). Differentiation according to spatial parts of the networks is also possible.

Second Best Theorem

Efficient pricing of transport infrastructure is a necessary condition for maximising the social surplus. If the objective is to improve the use of the existing capacity, the short-run efficiency principle is based on given capacity. In the long run the efficiency condition is that investments in transport infrastructure should be undertaken up to the point where benefits just exceed costs (Small, 1992).

However this result supposes inter alia that the remainder of the economy is at the optimum, i.e. prices, at least in the sectors of the economy related to the sector studied, are equal to the marginal costs, which is often not the case.

Faced with a non-optimal situation in the other sectors, a marginal cost pricing only in one sector does not necessarily lead to an optimum in this sector. This established fact corresponds to the "second-best" theorem (Feldman, 1997). Precisely, for Lancaster and Lipsey (p.12, 1956): *"Given that one of the Paretian optimum conditions cannot be fulfilled, then an optimum situation can be achieved only by departing from all the other Paretian conditions"*

This theorem of the "second-best" thus seems to singularly weaken the theoretical prescription of marginal cost pricing. However that does not call into question the principle of pricing in itself. There is thus a consensus to judge that it is more efficient to charge something in particular for congestion and environmental externalities, rather than to charge nothing or to charge a price disconnected from the marginal cost (Raux and *al*., 2000) The second best theorem suggests that if environmental costs are only partly covered in car sector or in aviation, also railways shall only pay an equal part of their environmental costs. The important aspect is to let the travellers meet the right set of relative prices between modes.

Ramsey principle

Alternative ways of recovering more than simply the marginal cost of infrastructure use from rail operators, with the least possible damage to efficiency have been proposed. The standard Ramsey pricing argument would justify raising price above marginal cost in inverse proportion to the elasticity of demand for the service in question.

In the case of the public goods, this pricing principle allows collective welfare maximization under a budgetary constraint. The theoretical aim is to minimize the dead weight losses in all markets. This is done by charging more where demand is less responsive to price changes. This is called the inverse elasticity rule. Mathematically, the mark-up over marginal cost is proportional to the inverse of the price elasticity of the demand.

Ramsey pricing provides a useful theoretical guideline. However, it requires a great deal of information. Both marginal cost and elasticity of demand must be quantified with a certain degree of accuracy (goal 6). The Ramsey rule has also been criticized for its failure to protect captive customers. Therefore, even if Ramsey pricing is the best way to ensure **efficiency**, it might turn out nasty in terms of reducing **welfare** for one or more customer groups. Moreover, as the tariff differs from the marginal cost, it is still possible that some services could be eliminated although their value is greater than their cost. It leaves some room for other kind of tariffs.

Stand alone cost

Multi-part tariffs leave ample room for negotiation. Thus, as was observed for the Ramsey rule, there is a possibility of market power abuse, particularly toward captive customers (Baumol, W., 1983). To prevent or at least limit this risk, a rule is used in USA: the Stand-Alone Constraint (SAC). This criterion is devoted to limit with a ceiling charge the market power of a monopolist offering infrastructure usage to any user or group of users (Kessides N and Willig R., 1995). The ceiling is defined as the cost (indivisibilities included) that the user would bear if it would be the sole user of the infrastructure. This might be considered as the price that a hypothetical alternate infrastructure provider could offer. Thus, it represents a surrogate for a hypothetical competition.

The aim of this ceiling is clearly to limit abuse of market power. It is probably too soon to assess the potential benefits of this kind of limitation for Europe. However, it is already possible to observe that in some very constrained situations, the market power is precisely linked to big indivisibilities. One example of that might be the tunnels under the Alps. This might rise the question if the SAC-rule could be applied with benefits for the railways.

Line by Line vs. Whole Network Cost Recovery

The following question arises when setting a fixed fee either to recover partly (marginal costing) or some additional cost recovery: Should this cost recovery be calculated line by line, or should it be calculated for the whole network? In case of SRMC- pricing, the complexity of the model should be decided based on a cost-benefit analysis, taking the effort of providing best possible data into account. In case of some elements of cost recovery, linking costs according to the price of the infrastructure seems natural. Of course, this must be based on sound economic surveys of price elasticities, cost-benefit analysis etc.

4.3 Review of Railway Infrastructure Charging Practices in Europe

4.3.1 Overview

The theoretical foundations of the infrastructure charging system linked to the objectives previously mentioned were presented. Now, the review of the practice in the different countries is needed for better understanding the infrastructure charging system as it is currently put to practice. As mentioned in the preceding pages, economic theory is rather precise on the question of infrastructure charges. However, this does not imply that practices are homogenous or even straightforward in this field.

A division between **railway infrastructure charges**, which are the pricing principles of being granted access to the infrastructure and **slot allocation pricing principles**, which are the specific part that relates to the price of being granted access to the track at a special section of the track at a special time, must be made.

In the case of a monopoly railway system, the latter pricing principle will be needless, but in the case of multi-operator railway system a fair and efficient slot allocation procedure is necessary. Environmental costs, accident costs, tear and wear of the infrastructure as well as delay costs are related to the first type of charging.

The second type of pricing, the slot allocation charges are set to distribute the track between operators, when there is more than one operator seeking slots in a special area at a special point in time. External costs will of course vary with the outcome of the slot allocation procedure.

Evidence from slot pricing in practice can support this view, as shown next.

4.3.2 Charging Practices in Member States

Austria

Austria changed from a dual part charging system to a linear part system in 1999. Today ÖBB charges two obligatory price components:

- one considering wear and tear with gross ton kilometres (gtkm)
- one charged according to train-kilometres

ÖBB currently uses higher charges on mountain lines, thus depending on the line type/train path.

Austria founded an association for the financing of railway infrastructure. The Schieneninfrastruktur-Finanzierungsgesellschaft´s (SchiG) tasks are:

- to set the charging system,
- to market the track network and
- to contribute to the financing of line upgrading or new lines incl. signals, stations, noise reduction, etc.

An improved charging system is currently under development. It is planned to be introduced in early 2003.

The new system will maintain the two parts - one charged on the basis of train-km, the other on gtkm – but will differentiate the price per train-km according to various features of the train or the train path.

Both, the price charged on train-km and the one charged on gtkm reflect marginal costs – for train operation and maintenance respectively. Their settling was preceded by cost studies. To the costs of train operation an extra charge according to the line used is added. These three components give the base price of a train path.

Up to three surcharges can be added to the base price. These reflect track scarceness and willingness to pay, and give an incentive to use track-friendly rolling stock

Table 1: Structure of ÖBB´s Charging System

Price Component	Economic Aspect	Indicator	Charged per …	Price
Train Operation	marginal cost of operation	train-km	train-km	not known yet
Tear and Wear	marginal costs of maintenance	not known yet	gross ton km	not known yet
Line Category Surcharge	infrastructure quality based	not known yet	train-km	not known yet
High Demand Surcharge	track scarceness	not known yet	train-km	
Train Category Surcharge	willingness to pay	not known yet	train-km	
Tear and Wear Surcharge for certain Vehicles	marginal costs of maintenance	not known yet	train-km	

Table 1 gives an overview on the new price components. Please note, that the new charging system is still "under construction" and no detailed indicators or prices are known yet.

Belgium

The SNCB uses in a linear charging system with two base components – one for the **use of lines**, the other for the **use of stations**. Both are multiplied with various coefficients, according to train type, load or commercial value.

Basic line charge

The basic charge per km is determined for each section by multiplying a unit price with two coefficients:

- **C1** is a coefficient relating to the commercial significance of the section. Railway lines were ranged, among other things, according to the overall (passenger plus freight) yearly revenues per km.
- **C2** is a coefficient relating to the technical equipment on that section and thus to the investment and the cost of maintenance. C2 may be reviewed after infrastructure improvements have been carried out.

Charge per train

For each train taking a line section, a charge is then calculated in multiplying the basic charge for that section by four coefficients:

- **C** is a coefficient relating to the overall gross load of the train. It is used to take account of the wear caused by trains to the infrastructure (tracks, points, catenary, signal boxes…).

  C is set by train weight classes as shown in table 2.

Table 2: Gross Load Coefficient of SNCB

Category	Tonnage	Mean	Coefficient C
1	0 – 400	200	**1.2**
2	401 – 800	600	**1.6**
3	801 – 1200	1000	**2.0**
4	1201 – 1600	1400	**2.4**
and so on	and so on	and so on	and so on

- **Pt** is a coefficient that depends on the quality of the service offered by the IM and in particular on the priority level allocated to the train in comparison with the other runs, especially in case the train movement is disrupted.
- **H** is the coefficient according to the time and day on which a train is running on a specific line section. Its purpose is to tune the infrastructure charge to time-related variations so as to increase the efficiency and/or to discourage customers from asking for runs that would take place during periods with heavy traffic (conduct of demand).
- **T** reflects the difference in duration of the journey of a train on a line section as anticipated and the duration of the journey according to the standard path. This coefficient is provisionally equal to **1** (no difference taken into account).

An overview of the price components which apply to the use of lines is given by table 3 below.

Table 3: Structure of SNCB`s charging system for lines

Price Component		Economic aspect	Indicator	Charged per…	Price or Coefficient on Unit Price
Unit Price		unit price	train-km	train-km	0,25 (1.1.2000)
C1	**Commercial Significance**	commercial significance	yearly revenue per line km	train-km	1,0 … 2,0
C2	**Technical Equipment of the Line**	capital costs	max. operating speed (amongst other indicators)	train-km	0,75…5,0
C	**Gross Train Weight**	marginal wear and tear costs	gtkm	train-km	1, 2…*)
Pt	**Type of Train**	willingness to pay	priority in path planning and operation	train-km	1,0…2,0
H	**Time of Use**	track scarceness	Traffic density	train-km	1,0…2,0
T	**Relative Speed**	opportunity costs	not yet implemented	train-km	not yet implemented

(*) steadily increasing with train weight

Charge for the use of stations and terminals

The stop at an installation (station, terminal, port) is charged separately. A differentiation exists according to the nature of the stop, the type of the train (passenger/freight) and number of trains that use the station per time, thus its commercial value or the track shortness.

France

Each year a bargaining process leads to the establishment of two amounts of money:

a) the total amount of access charges paid by the operator to the infrastructure manager;

b) the amount of money necessary for the maintenance of the infrastructure.

This amount is calculated by SNCF (the operator) while Réseau Ferré de France (RFF) collects the fees. The problem is that nobody can really appreciate that what is requested does correspond to actual expenses on maintenance. Although this amount represents some actual expenses, it is mostly a political transfer of money in order to improve the situation of SNCF. There is no precise link to actual maintenance expenses. This might change in the coming years.

As these flows are compensating them partially, the actual bargaining is on the difference between these figures. So far, this difference has always been in favour of the operator (SNCF). So each year, the government is bound to give to the infrastructure manager, who has no other revenue than access charges, a subsidy equivalent to the difference between maintenance charges and access charges. *Via* the infrastructure manager, the government is subsidizing the operator. If the new revenue for RFF doesn't cover the cost, additional public subsidies are asked.

As regards RFF, the infrastructure manager (and owner), it is principally facing investments which would have not been undertaken in the absence of public interest involved in the operation leading to this investment.

The rule is that none of the new operations can generate more costs that revenue (the only kind of revenue is the access charges). It follows that a new operation is under the obligation, in order to be accepted by RFF, to have a cost proportionate to the future revenue it can generate. If an investment is too high (compared to the access charges it can generate) the difference has to be covered by the State or local government (Provinces, "départements", municipalities or group of municipalities).

At the provincial level, the new reform, which has been experimented in seven provinces (Régions), and is now implemented in the entire country, states that the provincial authority has to buy to the operator the trains services it want to set up or expand. So, for every significant change in the provincial train services, there is a bargaining process on the technical possibility to actually make the proposed change and on the consequences of this change on the expenses of the operator (SNCF). For some services, it happens that the provincial government actually owns the rolling stock.

At the suburban level, concessionary fares are compensated by the transport local authority, which consists of a group of municipalities.

For the Parisian region, there is a somewhat more complex system of subsidies involving both the state and the different levels of local government.

The fees collected by Réseau Ferré de France take into account the infrastructure cost, the situation on the transports markets, the requirements of the optimal network use and the requirements of the harmonization of the intermodal competition conditions.

For the calculation of the fees for the use of infrastructure, "elementary sections" are defined as:

⇒ Suburban lines

⇒ Great intercity lines

⇒ High speed lines

⇒ Others lines

For each section, the fees for the use of infrastructure is composed by three parts:

⇒ Lump sum payment for the access to an elementary section according to the period

⇒ Payment for the reservation of an infrastructure capacity, due independently of the actual use of infrastructure. It is calculated from kilometric costs according to the section type. This cost can be changed according to the time of use, the origin and the destination, the time between the demand and the use actually, the train type, the commitment on the transport delay and the use frequency of the demand.

⇒ Payment for the actual use of infrastructure. It is calculated from the distance, the train type and the tons.

The lump sum payment for the access to an elementary section is calculated to take into account the charges of RFF. The weighting of theses three terms are fixed by orders (30 December 1997, 8 July 1999). For the years of 1997 and 1998 years if the network weren't to suffer any changes and if the number of trains is the same as in 1996, the order considers that the level of fees for the use of infrastructure would not be higher than 5,85 billionFrancs for 1997 and 6 billion Francs for 1998 (see Annex 1).

The supplementary fees for electricity is fixed to 0.105 by train-kilometres for all the type and subtype elementary section.

For freight the price for reservation of an infrastructure capacity is calculated with a factor equal to 0.484.

Tariff regulation concerning passengers: Theoretically, the operator can determine the tariffs freely, but the agreement of the government is required. However it must be observed that the operator has some influence on the government. In fact a bargaining process leads to tariffs changes from the previous year. It might happen however that the operator sets some new tariffs, for example for a new line, and that those new tariffs happen to be highly unpopular. In this case the State might intervene as a benevolent agent government and impose on the operator a strong recommendation to change the tariffs.

There is no ex ante limitation of tariffs increase.

The regional government can set up new tariffs, different than those of SNCF, under the condition that the adequate compensation is given to the SNCF.

Concerning freight, the tariffs are free from government interference, decided at the national level. The local agencies have very little power to renegotiate the tariffs (local conditions might be very different of what was decided at the national level).

Germany - Deutsche Bahn Netz AG (DB Netz)

The infrastructure charging system of DB Netz is a linear tariff, which settles the price of a slot (track time) in three steps (see figure 6):

- Settling of a base price dependant on line categories,
- Multiplying of a product factor and
- Multiplying and/or adding additional factors (surcharges).

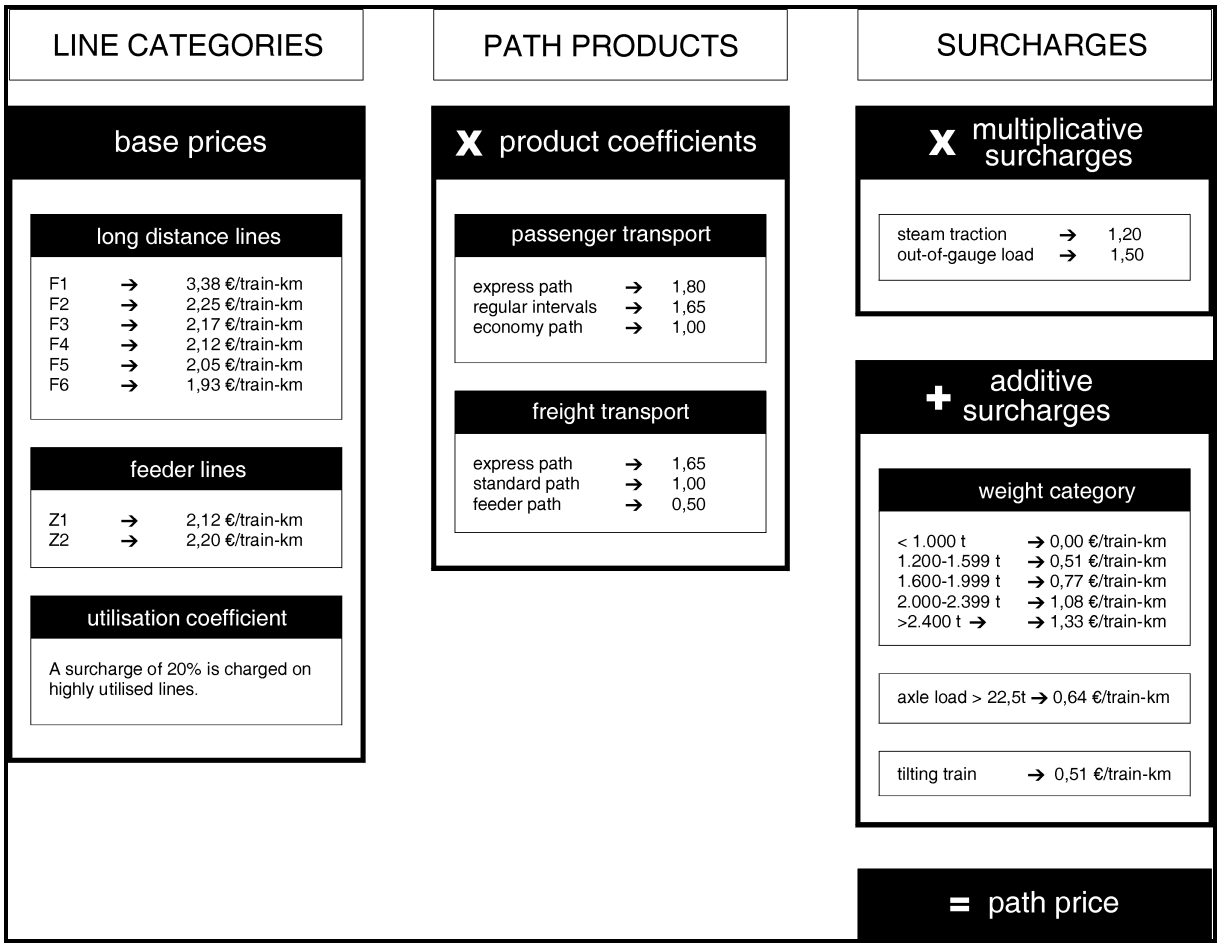


Figure 6: Charging Structure of DB Netz

Source: DB Netz

Line Categories and Product Categories

The **line categories** reflect the technical standard of the line as well as its functional role in the network. The most important indicator for the technical standard of a line is the maximum velocity. A surcharge of 20% is charged on highly utilized lines to manage demand

Table 4: Structure of DB Netz`s charging system

Price Component	Economic Aspect	Indicator	Charged per…	Price or Coefficient
Line Category	Infrastructure quality and willingness to pay	max. operating speed, equipment and line function	train-km	1,93 … 3,38 eur
High Demand Surcharge	track scarceness	traffic density	train-km	1,2
Product Category	willingness to pay	priority in path planning and operation	train-km	0,5 … 1,65

The **product categories** reflect the priority a path from route planning to delay management, and the mean velocity of the path:

- **Express paths** Fast and direct path between big metropolitan areas. This path has highest priority in timetable planning.
- **Standard paths** are available to all freight trains. Owing to the low priority there are few choices in timetable planning and therefore little flexibility for the train operator. Because of the priority of express (through) paths standard paths are constructed primarily between close junctions in the network but typically connecting standard paths beyond a certain junction are available to facilitate long distance.
- *A* **feeder path** must be connected to a standard or express path. It is provided solely for the distribution or collecting of wagons.

Surcharges

There are both additive and multiplicative surcharges:

- Out-of-gauge load: Trains that exceed the regular gauge may disarrange train paths on other tracks and cause higher planning expenses. Therefore a coefficient of 1.5 is multiplied on the line charge.
- Train Load over 1200 t:

Lines which can bear axle-loads over of 22,5 t need a superstructure above normal German standards. Trains exceeding this axle-load cause extra capital and maintenance costs and are charged an extra 0,64 Euro/train.km.

The system is average cost-oriented, which implies that total costs of operating and maintaining the network shall be prorated to prices. Nevertheless the total costs stated by DB Netz do not include capital costs and depreciations of all grants and the goal to pay running costs from slot or other track renting revenue was not achieved in the period 1998-2000 (according to Neuhoff (2001). In contrast, DB groups annual report includes a profit for DB Netz in 2000.

The federal states are responsible for planning, organisation and financing the regional rail service. Due to the fact that until 1993 the German state (DB & DR) has financed most of the regional rail service, the federal states get funds from the German state to finance the service.

The government pays investments in new lines suggested by the government. The government with 50% and 50% by DB NETZ AG pays investments in the current network. For any project to be realized and its funding a contractual agreement between the state owned railway and the regional authority has to be fixed. Obligations and resources are fixed in laws or in these agreements.

All investments the DB Netz AG will execute with state funds have to be negotiated with the government. Up to now this relationship causes some problems regarding application of funds and efficiency. This is a political explosive aspect. The distiction of what is an investment and what is maintenance is made by the length of a segment: it is considered as an investment if the segment where it occurs has a length of more than 1000 m.

Up to now there are no marginal cost aspects in the charging system of DB Netz AG. The actual charging system is full cost-coverage oriented. The former track charging system was designed as a two-part-tariff, but the Federal Office of Fair Trade due to discriminatory elements rejected it.

A little and static approach can be noticed due to the different allocation density the basic price is divided into 9 price levels an average utilisation factor of 20 % for some lines (it's static, so it's not real marginal cost). Furthermore the user has the choice of 6 product factors, considering different demand of timetable quality and travel time.

The high base prices for feeder routes are reasoned by DB Netz AG by their low utilisation, the low prices for suburban routes respectively vice versa. For freight transport the prices are corrected by the low product factor for feeder lines (collecting and distributing of cars), but not for local passenger lines.

Concerning the objective "flexible timetable and slot management" it is used for calculation of travel time, exact allocation time, train conflict potential. Any train path can be calculated in some seconds.

Passenger long distance: there is a small freedom from government intervention. The railway operator has to ask for authorization of his tariff and his terms. The authorization of the tariff can be denied regarding the EU directive 1191/69 § 1. The tariff and tariff conditions have to be published as well as inter-company agreements between infrastructure and operations management (charging system)

Regio: the tariff is worked out by the operator itself or by the respective public authority of the federal state. The respective public authorities of each federal state perform the coordination between all public transport enterprises of the regarded region as well as the tariff permission. Inter-company agreements between infrastructure and operations management: charging system of the DB Netz AG and DB Station & Service AG.

Cargo: freedom from government intervention. The operator is negotiating the tariff with the customer. Besides there exists up to now a published tariff for some goods, but it is freely set. Inter-company agreements between infrastructure and operations management: charging system of DB Netz AG.

Greece - OSE

Up to now, the marginal cost pricing principle is not used in Greece for the calculation of infrastructure charges.

Passenger traffic: OSE has no freedom to establish its own tariffs. So OSE proposes to the Government a tariff structure and Government reviews all tariff changes and ultimately approves or rejects.

Cargo: Up to now OSE is obliged to propose to the Government a basic tariff structure, which Government accepts, or refuses. There exist the possibility of granting reductions on tariffs after relevant decision of the Board of Management.

During the process of the financial improvement of the Greek Railway Undertaking special measures have been taken by the State.

The Netherlands

The charge for passenger traffic is based on the following formula:

(Passenger train km. * A) + (Stops at larger stations * B1) + (Stops at smaller stations * B2)

Where A, B1 and B2 are charges set by the Minister.

Freight traffic charges are based on the following formula:

Freight train km * A * M where M is a parameter that will increase during a transition period

M is set at 0.3 for 2000, 0.4 for 2001, 0.5 for 2002, 0.6 for 2003, 0.7 for 2004, 0.8 for 2005, 0.9 for 2006 and 1.0 for 2007 and all year thereafter.

The (variable) costs that have to be covered by the charges are costs for:

⇒ Daily maintenance carried out by Railinfrabeheer[1] (RIB)

[1] currently PRORAIL

⇒ Major maintenance by RIB

⇒ Employment with RIB

The Act of 25 October 1999 (Stb. 457) that introduced the charging scheme determines that 15% of these costs should be covered by infrastructure charges. This will increase to 100% in 2005. Consequently, the parameter values will rise during the period 2000 to 2005. The values applicable to passenger transport by NSR on the basis of the performance contract for the operation of passenger services on the main network are the following (where we can see the increase over the years as a larger percentage of the variable infrastructure costs needs to be covered):

Table 1: Time series of Dutch charging components

Charging components (in Guilders)	A	B1	B2
2000	0.3082	0.9746	0.2271
2001	0.6161	1.9492	0.4541
2002	0.9242	2.9237	0.6812
2003	1.2322	3.8983	0.9082
2004	1.6430	5.1977	1.2110
2005	2.0537	6.4972	1.5137

This is expected to result in payments by NSR for infrastructure usage (core network) in million guilders: 30 (for 2000), 60 (for 2001), 90 (for 2002), 120 (for 2003), 160 (for 2004), and 200 (for 2005). For the other services (passengers and freight) on the Dutch rail network, yearly set parameter values apply on the basis of the expected level of costs and total number of train kilometres run. For the years 2000, 2001 and 2002 these were/are the following:

Table 2: Dutch charging components

Charging components (in Guilders)	A	B1	B2
2000	0.3082	0.9746	0.2271
2001	0.6215	2.0749	0.4697
2002	0.4409	1.4603	0.3340

Those interested in accessing the railway network should submit an application to Railned. Its independence should guarantee non-discriminatory access.

The distribution of capacity between goods and passenger transport: a policy-based development path will be agreed for the distribution between goods and passenger transport as regards the volume to be fitted in. For goods transport, operators will partly have to request the capacity themselves and the capacity allocator will partly reserve capacity for short-term requests.

Priority is given to goods transport on the rail network in the early hours. Priority for passenger transport in the rush-hours, while goods transport will be limited to a minimum level.

In the off-peak hours, passenger transport has a slight priority.

Exploitation subsidies for passenger transport operations have been phased out in the period from 1995 to 2000. These sums were more are less replaced by compensations for the contracted regional unprofitable services.

Portugal

The Operator Fertagus is the only railway undertaker that has been newly formed and is not a result of the vertical split of the previous National Railway Company. Its tariffs are valid for a specific concession and are established in their Concession Agreement, which was negotiated with the Government.

The Fertagus infrastructure charge is therefore defined at its concession contract. This fee is calculated based on the usage tariff by train unit accordingly with various criteria defined on the Concession Contract, including the variations of traffic volume.

The infrastructure charging system for most of the network where CP operates (The National Public Railway Undertaker) has been recently defined, following interventions by the IM (REFER), by the regulator and by Government. REFER still has to receive direct financial compensations from the State.

The Regulation (19/2000) defines the infrastructure usage fees as being calculated annually. These fees have to cover totally the infrastructure management costs, calculated on the basis of the technologic and operational most efficient conditions, in terms of quality and reliability of the railway management service.

The usage fees will take into account the measurement in kilometres, the rolling stock material, the speed, the freight by axle and the time spent using the infrastructure.

The infrastructure management costs for the estimation of the usage fees are the following:

- Track preservation costs;
- Signalling costs;
- Telecommunication costs associated to the command and control of the circulation;
- Bridges and Tunnels conservation costs;
- Preservation costs of the electric traction installation;
- Command and control costs of the circulation in the command posts, including the
- Centralised traffic command;
- Command and control costs of the circulation in the stations with regulated and safety obligations, independently of being protected by distance command;
- The costs associated with the staff intervention of the infrastructure manager, regarding indispensable activities for the circulation of trains;
- The costs of provision and preservation of the railway crossing, if it does not exceed 50% of the total cost of conservation, exploitation and investment;
- Operational costs related with the circulation control and conservation managers;
- Quays, Platforms and Technical buildings preservation costs.

There are no reservation charges in the fee.

Till this moment, the marginal cost pricing principle is not used in Portugal for the calculation of infrastructure charges.

<u>Delay costs:</u>

Italy

Trenitalia after implementation of EC directives 91/440 95/18, 95/19 and after the split to other companies (controlled by FS Holding), is no longer allowed to receive public funding, excepted those paid as compensation for public service obligations. The fares applied for passenger services are under regulation.

According to DPR 277/98, art. 7.2, the charge should cover the direct and indirect costs, energy, direct general expenses and part of the indirect ones. It is calculated in order to balance the circulating costs on network level, and not on each single path (principle of network solidarity).

The railway sector in Italy has been restructured very recently (2000) and, today, 17 licenses have been issued. Among these, one has been issued to Trenitalia Spa. (part of the former vertically integrated national railway company), which currently is the principal operator and the only one providing passenger services.

The charging system has been fixed in a Ministerial decree (DM 43-T): it includes 2 elements:

⇒ one related to access to any of the sections,
⇒ the other related to the usage characteristics.

The total access charge is the sum of the following factors:

⇒ the charges for the sections on the primary network,
⇒ the use of the complementary network,
⇒ the charges for access to nodes.

The usage charges depend on train speed and weight, traffic density, time band, and the use of the main stations in nodes. The costs of energy are calculated on the effective usage (only for electric trains).

According to the last version of the Network Statement (31.5.2001), which has been published on these, the “base” access package provided by the Infrastructure Manager to TOCs, includes all the items listed sub point 1 – annex II of Directive 2001/14 and electricity for traction (separately charged, according to individual consumption).

As an extension of the "base" access package, the Infrastructure Manager must provide, if requested by TOCs and after payment of an additional charge, the following other services:

⇒ electricity for pre-heating/air conditioning of rolling stock;
⇒ routing of rolling stock to freight terminals (where are provided also craning services, operated with stationary cranes) and to those tracks equipped for refuelling, washing, inspection of carriages, etc.
⇒ extra-time train parking on a given track or railway plant;
⇒ water restocking;
⇒ train ferrying to/from Sicily and Sardinia;
⇒ train shunting and composition before/after ferrying to/from Sicily and Sardinia.

According to new regulations, all these services must be charged according to costs incurred. To comply with the “Contratto di Programma”, the Ministry has issued the DM 44-T, which fixes a discount on the total charge as a compensation for extra-costs of operations

This consists of 2 parts, one related to the state of the line, and the other to the volume of traffic (freight, long distance passenger, or regional service).

TOTAL CHARGE = ACCESS + USAGE + (ENERGY) - DISCOUNTS

With regard to the newcomers (operators), they have to face all the difficulties which are typical of a capital intensive and technologically exclusive industrial sector, such as the lack of secondary markets for almost all the production factors, the presence of economies of scale, the burden of high sunk costs and so on.

They can participate to tenders for public service contracts, both at regional and at the national level, according to the scale of their industrial production, and therefore have access to contributions from the public sector, as a compensation for public service obligations.

United Kingdom

The initial system of infrastructure charges implemented in Britain for passenger franchises relies on a two part tariff, which involves for allocated access right a marginal cost based solely on wear and tear and where appropriate electric traction costs, and a large fixed element based on avoidable costs and on an allocation of joint costs (Office of the Rail Regulator, 1995). In addition, the franchise agreements contain "performance regimes" which specify penalty payments or bonuses according to specified performance criteria, such as punctuality and cancellations.

The SRA awards franchises to the TOCs for a specified period, following a competitive bidding process. The regulator controls and monitors track access charges paid by the TOCs to Railtrack. There is also the opportunity for services to be provided by non-franchised open access operators, which is controlled by the Regulator.

Railtrack has a financial incentive/penalty contract with the TOCs, and this is based on meeting a target for permitted delay for a group of train services over a four-week period. In addition, Railtrack is liable to penalty fines from the Regulator for poor performance and the usual incentives of a public limited company. The original incentive structure had a number of difficulties: operators were faced with negotiating costs and benefits with a monopolist (Railtrack) leading in practice to high transaction costs and lengthy negotiations. This asymmetric relationship meant that there was little transparency in the process of setting charges for the new services that the growing railway required. The 2000 periodic review by the Regulator addressed this with a review of the charges focusing on:

- Growth in the use of the railway network,
- Improvements in performance – to improve number of trains on time,

The tariffs for passenger train operating services (track access charges) paid by the TOCs to Railtrack are inter-company agreements, controlled and monitored by the ORR. The initial regime was set by the Government, but later **replaced by an RPI minus*regime**. The freight access charges were negotiated between British Rail (the pre-privatisation organisation) and the Railtrack and approved by the Regulator.

The train crash at Hatfield in October 2000, and the consequent major repairs required across the whole British rail network, is estimated to have cost in the order of £580 million. This, and other debt issues, caused Railtrack to approach the government for funding, which it controversially used in part to pay a dividend to its shareholders.

When Railtrack first floated in 1996 shares were offered at a price of £3.90 per share. The share value peaked in November 1998 at £17.68 and was approximately £10.40 at the start of 2001. By the close of the market on October 5 of 2001, the share value had fallen to a low of £2.80. The £370 million held by Railtrack Group were frozen at the time the company went into receivership and have been earmarked to pay Railtrack shareholders an estimated 70p per share in compensation.

The tariffs for passenger train operating services (track access charges) paid by the TOCs Railtrack are inter-company agreements, controlled and monitored by the ORR. The initial regime was set by the Government, but later replaced by an RPI minus*regime. The freight access charges were negotiated between British Rail (the pre-privatisation organisation) and Railtrack and approved by the Regulator.

Railtrack produces an annual Network Management Statement (NMS) outlining the company's expenditure proposals for the maintenance, renewal and enhancement of the network. The NMS also

includes information on Railtrack's expectations for the growth of passenger and freight traffic capacity and demand, and identifies current and potential traffic bottlenecks. This is closely scrutinised by the Regulator.

Standards are set by Railway safety, a whole-owned subsidiary of Railtrack, and approved by Her majesty's Railway Inspectorate (HMRI).

Both Railtrack and the TOCs are public limited companies and therefore operate on commercial grounds.

Over the past few years Railtrack has been severely criticised for both its performance in improving the railway infrastructure and for its safety record. In October 2001, the British government put the company into receivership after deciding its current level of indebtedness no longer made it financially viable as a commercial organisation without regular handouts from the taxpayer. The legislation that created it prevents the actual infrastructure being sold to pay debtors.

Given the arbitrariness of the allocation of joint costs, the system does not necessarily provide good information on the relative profitability of different services. Moreover, the system has been criticised for the very low variable element in the charges, which give too great an incentive to fill scarce track capacity with lightly loaded trains. The variable charges include none elements either to allow for congestion or the opportunity cost of slots or for externalities such as air pollution. Moreover it gives no incentive to Railtrack to enhance capacity to provide for extra services, in fact, Railtrack argues that the variable element does not even cover wear and tear cost, so it is clearly in their interest to discourage capacity expansion from the point of view of efficiency, the result is that the system has no mechanism to ensure efficient use of scarce capacity (Nash and *al.*, 2001).

4.3.3 Charging Practices in Accession Countries

Bulgaria

Infrastructure fees are determined by the Council of Ministers (Article 10, par. 1, item 3)

On each 1st of January a new yearly actualised fee grid comes into force.

Improved cost and tariff policies for NC"RI" are basic prerequisites to its improved financial performance as a transporter of commodities in bulk and as mass carrier of commuters and intercity travellers.

This will require:

- marketing NC"RI" services on the basis of costs;
- improving NC"RI" cost accounting systems;
- basing NC"RI" planning and management on actual costs, not theoretical norms;

The planning for M&R of INFRASTRUCTURE – based on the market value of the materials, unit costs of spare parts, unit prices for the equipments and machines, workers salaries etc for maintenance and repair of the railways.

The railways are considered to include the following elements:

- Rail buildings – Stations ,Duty points, storages, Trolley garages
- Structures - Bridges, tunnels,
- Track - ballast ,sleepers ,switches, etc;
- Catenary–cantilevers , cables, feeders;
- Power supply- transformer, low and high voltage elements, masts and others;
- Substations;

- Signaling and Telecommunications,
- Automating NC"RI" cost accounting –sector QPM (quality projects management).

Romania

At CFR National Company, the tax for using the infrastructure was fixed, having a logical value and taking into account the real possibilities of the commercial operators, minimum necessity of expenses for maintenance of railway infrastructure, data correlated with the experience of 1998-1999.

According to GD 698/1999, CFR National Company provides distribution services of the railway infrastructure capacity only with the condition to conclude access contracts and with the payment of a tariff of infrastructure use for the assigned capacities, according to the law.

CFR National Company can negotiate the level of tariff for using the railway infrastructure with the railway transport operators, depending of the number of the acquired train-path, traffic section, the moment and period of request.

The order (priority) granted to infrastructure is the following:

- High class passengers trains;
- Common passenger trains;
- Direct freight trains;
- Local goods trains.

In order to access the Romanian infrastructure it is necessary to have the license issued by AFER.

The Calculation methods are set by CFR–SA, which elaborates the calculation methodology for railway infrastructure tariff based on commercial principles, taking into account the fixed and variable costs for railway infrastructure use.

The calculation methodology allows each operator to pay for the real costs of the services ordered and benefited effectively, by fixing separate tariffs by activity type. The calculation methodology is included in the activity contract through additional act.

According to GD 698/1999,in 1999, the new licensed railway operators excepting CFR Freight and CFR Passengers had to pay monthly amounts which were established al percentage quotas from the achieved incomes for using the railway infrastructure, as it follows:

⇒ 39.8% for a railway passengers operator;

⇒ 32% for a railway freight operator.

For the payment delay of the tariffs for using the railway infrastructure CFR can decide to stop the access services on the railway infrastructure for the operator involved in this situation.

The tax for using the infrastructure is paid to National Company CFR for providing the basic package and compulsory services (for example the assistance in case of serious incidents).

The basic package includes the following services:

- The right of access to the public infrastructure elements;
- Using of the line and the infrastructure elements necessary for train traffic and shunting operations;
- Using of the catenary hanger and providing of the traction electric power (without the equivalent value of the electric power);

- Distribution of train-paths;

programming, co-ordination and train traffic according to the distributed train-paths (traffic management, signalling and traffic safety installations, telecommunications services).

At present the methodology for TUI (access tax) calculation is underway and it takes into account the following:

- In case of freight transport, tariff discounts are granted in order to use the infrastructure for operators, who require a greater number of routes.
- The cost of a route is higher during traffic peaks than in that with reduced traffic.
- Tariff reductions are applied for use of infrastructure in case of mass (bulk) transport (coal, cereals, coke, construction materials etc.).

In accordance with Government Decision no. 3/2001, MLPTL is special authority of central public administration, with juridical personality, subordinated to Government and fulfils the following principal duties:

- Ensure to all users free access, without making any discrimination, to transport infrastructures which are open to public access;
- Elaborate and submit the rail infrastructure tariffs in order to be approved by Government,
- Conclude, on State's behalf, activity contracts with: CFR National Company, national and/or commercial societies that perform public passenger transport.

MLPTL in its capacity of State authority in transport field, has the following duties, which it exerts directly or by technical specialized bodies, subordinated public institutions and units or authorized commercial companies:

- Grant on mutual basis to foreigner users, the right to freely use transport infrastructure or to pay it;
- Issue compulsory norms to license and authorize economic agents, which perform or will perform transport activities or specific activities for traffic safety;
- Establishes conditions for granting, suspending or withdrawing of licenses and authorizations.

Access to rail infrastructure is made on the basis of:

- Rail transport license
- Safety certificate
- Specific instructions and regulations
- National legislation and international conventions to which CFR National Company and transport operators are parties.

Freight: the Government does not intervene in establishing the tariffs for freight railway transport.

Passengers: according to the Law 89/1999, the public railway transport for passengers has social public service character. For these services public railway transport operators receive from the State or local budget, the differences between the tariffs established with the approval of the competent public authorities (the State) and the real costs of transport, to which a profit quota between 3 and 5% is added.

According to the Governmental Decision 41/1997, CFR National Company can establish provisions in order to reduce the tariffs or other advantages, or can give tariff reduction for commercial purposes.

According to the contract of access to the infrastructure, CFR National Company provides basic, additional, compulsory or optional services. While performing his activity, licensed transport operator must

achieve, in due time and at technical parameters stipulated in indications for safety of rail traffic, all verifications, maintenance and repair operations for rolling stock in the traffic, otherwise it is punished by suspending or withdrawal of his license.

4.3.4 Charging Practices in Other European Countries

Norway

Infrastructure fees shall be fixed with a basis in the principles enshrined in Directive 95/19/EEC. The fees shall be paid to the infrastructure manager. The fee is set by the Parliament on a yearly basis and is based on the marginal cost pricing principles where external costs are internalised. On the new line from Oslo Central to the airport there is an additional fee (mark-up). The fee is meant to cover parts of the investments costs and the government calculates it.

The fees are determined by the Parliament on a yearly basis and should reflect long term marginal costs associated with use of the infrastructure. Corrections according to "second-best principle" were made for any deviation from marginal cost pricing for competing modes of transport. Later the pricing-principle for the fees is changed from long term marginal cost pricing to short-term marginal cost pricing.

Train operating management: the PSO contracts between government and the NSB BA, is governed by three contracts and based on ex-ante negotiations. A main contract describes the main objectives of the contract relationship and also describes the contract framework and what premises it is built on. This contract has no specified timeframe, but either part may terminate the contract with a 6 months notice. A four-year framework contract specifies developments of the intended level of production and what the government intend to use on PSO contracts the next four-year period. A yearly contract gives a detailed description of the level of production and the expenditure that year. Parliamentary bills in Norway are based on yearly resolutions. In addition there are two separate PSO contracts concerning ticket discounts for students and military personnel.

Infrastructure management: No PSO. Jernbaneverket as the infrastructure manager get most of the financing through direct governmental expenditure over the state budget. Some minor financing is provided through various small commercial engagements. Institute of Transport Economics (TØI) (Report 472/2000) has done the last evaluation of the fee. The results given in this report was used when the Parliament fixed the existing fees. The formula of Institute of Transport Economics includes costs of producing infrastructure services, maintenance and externality costs as pollution, noise and accident i.e. short run marginal costs (see annex 4).

Because of an aim of a level playing field between modes the fee is reduced from to the principal of second best, as the competing modes do not pay their external costs. The benchmark modes in the calculations have been bus for passenger transport and truck for freight transport.

Calculated charges (NOK) for different categories of trains pr. Gross ton km under the assumption of second best is:

Table 3: Infrastructure charges, Norway

Freight		Passenger	
El	Diesel	El	Diesel
0,012	0,022	-0,001	-0,001

Prices in Euro are roughly calculated by dividing the above numbers by 8.

Out of political considerations of the infrastructure standard (both on roads and rail) in rural areas (diesel lines) and the importance for the forestry to be able to use train services, the diesel trains are subsidised by paying the same fee as the trains run on electricity. There is no infrastructure fee for passenger trains.

All in all, including other taxes and fees (taxes on electricity, CO2, VAT etc.) the freight trains should cover about 60% of the short run marginal costs. The infrastructure fee should cover about 43%.

The “mark-up” on the Gardermo-line is estimated by expectations of the willingness of payments from the undertakings and is meant to cover parts of the investments costs. The “mark-up” of to day and the priority payment of Flytoget will over a period of 30 years cover 45 % of the investments costs of the Gardermo-line.

There are no reservation charges in the fees.

For services that are not covered by PSOs, the train operators has no limitations in their calculation of tariffs for train services, but the Ministry shall approve the fines for passengers caught without holding a valid ticket. In November 1996, NSB's former traffic division was converted to NSB BA, a company created by an Act of Parliament, with effect from 1.12.1996. The infrastructure manager, Jernbaneverket, was established at the same time. This change means that NSB is no longer subject to government administration. NSB itself now has commercial responsibility for operating the rail system and finances investment through its own income or loans. NSB BA is owned by the Ministry of Transport and Communications who is the general assembly. However, the government is only responsible for contributing capital and therefore has limited responsibility (BA). After changes in the Act in May 2001, where the employees rights as public servants was removed, the act are now equal to the ordinary joint stock company regulation.

Switzerland - Schweizerische Bundesbahn (SBB), Bern-Lötschberg-Simplon-Bahn (BLS) and other Railways

The tariff of the Swiss railtrack organizations is regulated by the “Bundesamt für Verkehr“ (BAV – Federal Transport Administration). It consists mainly of two parts:

- the marginal costs of the train run (= minimal price) and
- a contribution margin.

Additional charges are raised for various services related to railway operation; including the handling and storage of wagons, brake trials etc.

Marginal Costs

The marginal costs determine the minimal price to be paid. They are composed of three parts (see NEXT table):

- maintenance costs which on the base of gross ton km 0,0017 Euro/gtkm,
- train operation costs, which include trackside operating staff and are charged on the base of train-km 0,273 Euro/train-km ,
- energy costs which differ according to train weight and train type (fast accelerating local trains have the highest price per gtkm) 0,0017 … 0,007 Euro/gtkm,
- (lump sums for use (stopping or passing) of a junction. Big and small junctions are differentiated. Whether a station is counted as a junction depends on the number of diverging lines and the number of switches).

Table 4 - Structure of SBB's/BLS's Charging System

Price Component	Economic Aspect	Indicator	charged per…	price *) or coefficient
Minimal Price				
Maintenance	marginal maintenance costs	fixed price	gtkm	0,0017 EUR
Train Operation	marginal operation costs	fixed price	train-km	0,271 EUR
Energy Supply	marginal energy costs	train type	gtkm	0,0017– 0,007 EUR
Use of a Junction	marginal staff and maintenance costs	number of lines and switches	dep. + arr.	2,030 / 3,383 EUR
Contribution Margin				
Contribution	willingness to pay capital costs	fixed price	ntkm	0 - 0,0035 EUR **)
Relative Speed Surcharge **(BLS only)**	opportunity costs	number of regular slots used	train-km	1,35 / 2,71 EUR

***) Exchange rate by 1.1.2002.**

****) The contribution in some cases is assumed by BAV.**

Contribution Margin

The contribution margin for cargo services is 0,0052 EUR/net-ton-km while the one for non-regular passenger service is 0,0027 EUR/timetable-km.

Additionally the BLS charges an extra fee for slow trains using more than one slot (of regular speed).

4.3.5 Charging Practices in USA

The US railroad network inherited over capacity from the period of strong development of railroads to an extent rarely seen in Europe. But the various lines were also supplying railroad services to different regions. So, in order to maintain both competition between different possible routes and services in the various regions crossed by the different routes, a very precise and imperative regulation was set up (Button, 1993, Boyer 1997) . This regulation was affecting both freight rates and access charges. Railroad companies are generally vertically integrated, thus the question of access to the track is to be addressed with the possible anti competitive behaviour of the owner of the track which simultaneously runs some trains of other operators on it. Since the mid 70s and ending in 1980 a move toward deregulation took place. This deregulation caused a big restructuring with mergers and closure of under utilised lines. Now some residual regulations remain. In particular the supposed captive shippers are protected by the "stand alone cost" principle described earlier in this document. Moreover, each rate exceeding a given ceiling (in 1997 180 % of the government calculated variable cost of movement) might be put under the examination of Surface Transportation Board in order to check if there is a market power abuse. But various attempts

to apply this principle to the "bottleneck" problem have failed. In this problem, the shippers or the railroads have to use a "bottleneck" track to access a certain point, for example a power plant using coal. Until 1998, the captive users, shippers or railroad, of this "bottleneck track" didn't obtain the application of the regulation principles on the bottleneck facilities (Jahanshahi, 1998). Apart from regulation, railroads are free to negotiate contractual agreements for track sharing, including the main following types of contracts.

- Trackage rights: one railroad uses the tracks of another on a fee-for-service basis.
- Paired track agreement: when two competing railroads have parallel tracks they can integrate their tracks in order to increase the capacity on this pair of lines.
- Joint track agreement: co-ownership of tracks by several railroads with alternate responsibility of maintenance and dispatching.
- Joint subsidiary: a joint track agreement where a common subsidiary is set up.
- Reciprocal operating agreement: quite similar to the operator/infrastructure manager separation instituted by the European directives. In this case the track owner is paid on a tonnage or fee–for-service basis.
- Reciprocal switching: exchange of cars between railroads.
- Detours: the track of a railroad is used by another in order to avoid service interruption
- Pooling: to form a train with cars belonging to several railroads companies

In spite of those various agreements, it is generally agreed that there is no "true" open access in numerous market segments. It follows that the competition is to be with other transportation modes, particularly road haulage.

5 Overview of slot allocation procedures

5.1 Objectives of Slot Allocation

The main objective for rail infrastructure charges and slot allocation charges is to promote the efficient use of the rail network. This is related to both the level of infrastructure use, so that there are neither too few nor too many trains using the network, and the pattern of infrastructure use, so that scarce capacity is allocated efficiently between different train operators. The charges are set as to reflect the costs one additional train running on the tracks puts on society.

If charges are correctly set from the point of view of social efficiency, theoretically, available infrastructure capacity will be efficiently allocated between train operators.

A second objective is promoting efficient investments in rail infrastructure. Possible ways to do this is by rewarding infrastructure managers for improving cost efficiency, for reducing delays to train services, and by giving the infrastructure managers motivation and insight to expand the network where the potential demand is biggest.

A third objective for railway infrastructure charging is to decrease the need for public funding by introducing charging rules that assure cost coverage of infrastructure investments.

In practice there will be a conflict between efficient provision of train services and the objective of financing the infrastructure investments, and therefore it is necessary for the policy maker to consider what are the most important goals to achieve.

When are railway infrastructure charges needed?

All provision of railway services should cover its external costs, and there will always be elements of external costs in the train operating services. Departures from this principle can be justified, by using second-best pricing principles. This will be explained later.

When are slot allocation charges needed?

There are ways to allocate track in time and space without slot allocation charges. Before the liberalisation of the railway market, the timetabling procedure was a task of the railway company, and the timetabling procedure did not involve any conflict with other operators. As more operators enter the market, the body that designs the timetable has a increasingly demanding job, trying to make a timetable that doesn't discriminate operators and at the same time takes the public demands into account. It should be clear that all these goals become impossible to fulfil as the number of operators grows. In this situation a market for slots may be a good solution.

5.2 Discussion on Mechanisms for Efficient Slot Pricing in Railways

5.2.1 Properties of the railway system

This section is dedicated to the examination of how an economically efficient allocation of track capacity between operators can be achieved.

Before the separation of train and track, the national railways were able to carry out an integrated analysis of track allocation and costs and revenues from the operation of these trains. Revenue is of course closely linked to the demand side, and how well the willingness to pay is exploited. In the new regime, starting after the implementation of the EU-Directive 91/440, the actual allocation is in the hands of the infrastructure manager separated from the operators. The operators are left to concentrate on the cost/ revenue considerations. In an area of competition all operators are interested in running the most profitable routes. Other routes at other times of the day may be less lucrative, and some routes may not be profitable at all and no operator will ask for these slots without some public funding.

Competition on track demands a way to allocate the railway capacity among different train providers. There are many ways of doing this. In order to find the best way of allocating capacity we need to consider the following criteria:

- Efficiency
- Fairness in allocation, equity
- Financial objectives

The railway system (network) in a country is divided into lines and blocks. Blocks are defined as a distance of the track that can be occupied by only one train. As there never can be more than one train in each block, the problem of timetabling is to prioritise which trains that shall be granted the right to run in each block at a special point in time.

As the signalling and safety systems are improved the length of the blocks may be shorter and thus increasing the capacity of the track. These blocks, formerly a fixed constraint associated to the physical segmentation of the network have since evolved in to a more dynamic concept by which a certain length before and after the train is reserved for the train according to its speed allowing for increased slot management flexibility.

This concept called "'moving' blocks" has been introduced in several countries. This concept indicates that blocks move with the trains. This is a result of the introduction of new safety systems.

Given these facts and rules, finding a way to translate economical rules for optimal provision of railway capacity and train capacity into a feasible and manageable system becomes the important issue.

On the supply side the basic concepts are:

Capacity: the capacity is a limited resource in two dimensions: time and space. The constraints are in practice not physical constraints, but constraints related to some security measure.

Safety is linked to the density of trains on track, and the technology both on infrastructure and trains. Railway administrations distinguish between the two concepts called theoretical and practical capacity. The first is connected to the maximum level of traffic that can run on the track given the current state of the infrastructure (curvature, signalling etc), and the latter related to what is regarded as practicable given the existing train material, the current mixture of local slow train and high speed Inter City traffic, and current operational practice.

The current opinion is that practical capacity is 75 per cent of theoretical capacity (UIC-norm). The track is divided into blocks, which are defined as section of the track that can be occupied by one single train at a time. For a single-track line this is regularly the distance from one meeting station to the next. The capacity of a certain line can vary by the following variables:

- Mixture of trains (slow and fast going trains on the same track reduces the number of trains that can be operated within the same time period).
- Technical attributes like acceleration and deceleration properties as well as the minimum time between trains, which depends on speed, signalling and block lengths greatly affect the capacity of the track.
- Station areas which functions as crossing lines for trains, but have often speed limits. Some stations are just served by local trains, while regional trains do not stop. This will reduce the total capacity of the section, compared with a section without such stations.

The acceptable level of capacity exploitation is a function of requirements for punctuality and reliability, ability to normalise traffic after an incident or a delay, demands for speed, and finally influences from traffic in other parts of the railway system.

The **demand** for railway services can be explained by a regular demand function including income and prices, but varies greatly in the two dimensions time and space. Demand varies with time in at least two ways. The obvious one is the actual needs of the consumer.

If the working period generally starts at 9 am, obviously the willingness to pay (WTP) for a train arriving 9.30 is low. As adaptation to a new timetable has some costs for the passenger, and most daily passengers are using some kind of periodic card, the changes in demand due to changes in the timetable are slow. Furthermore, passengers dislike frequently changing timetables.

Reliability, **Punctuality** and **Quality** are important concepts, which are affecting demand, and closely connected to the density of trains on the tracks. If the capacity limits are trespassed, the effect on the total traffic of a delay of one single train may be great.

The allocation procedure will need to consider all these elements in order to find some optimal allocation rule. Once this allocation is done, a timetable is fixed for a certain time e.g. one or two years. The routes will for certain areas and time of the day be fully exploited by the operators, but for other areas and time of the day there may be free capacity, giving room for additional traffic.

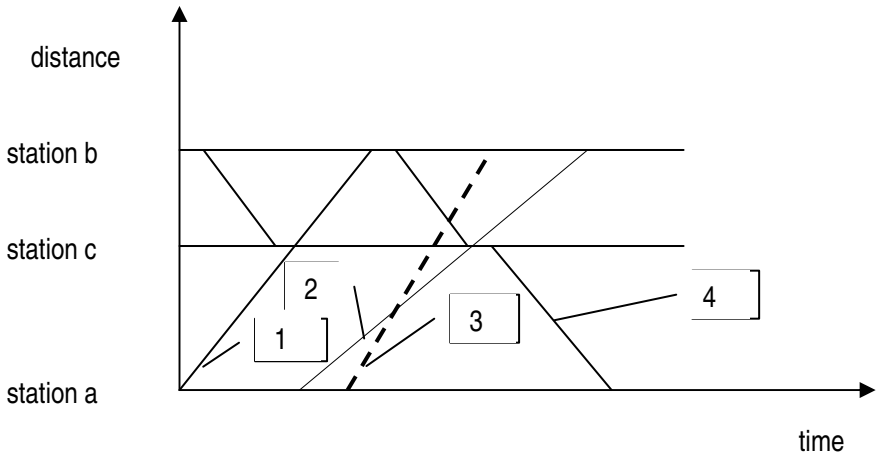
What has been said so far in this section does not involve economic tools. The variables can all be placed within a pure engineering solution.

5.2.2 Track allocation

Allocation of track access is not new, and was already an important matter when the national railways were the sole train operator. The national railways needed to allocate the track between different trains. This allocation procedure is a quite demanding task involving many objectives and considerations.

The figure below illustrates a railway consisting of three stations and two blocks. One block between station a and station c and another block between station c and station b. Time is on the horizontal axis and distance on the vertical axis. The inclining lines indicate different trains, and the slope represents the speed.

Figure 2: An example of conflicting train departures on single-track section with two-way traffic



Five trains are shown in the figure above. Three leaving station “A” and two trains arriving at station “C”. There is just one conflict between these five departures. The train illustrated with the dashed line “3” will catch up with a slower train “2”, and is therefore not fitted into a feasible timetable. Besides, the fast-going train will meet an opposing train “4” between station c and station b. We see that train 4 stops at station c, whereas train 1, 2 and 3 are non-stop departures between station a and station b.

Old fashioned track allocation can be described as trying to find the best way of allocating certain train departures, given considerations of speed, frequency and priority. The latter is a disadvantage of the old engineering system, since there is no objective way to ensure fair and efficient distribution of slots between operators with conflicting requests.

5.2.3 Connection between slot allocation and pricing of access to track

As both economically founded slot allocation and SRMC-pricing of track are techniques that have not been widely used and thus information about them is scarce there is a need to explicitly draw some practical implications of the use of these methods.

An orthodox use of the SRMC-pricing principles will make the time costs in the track system an endogenous variable in the slot allocation procedure. An additional train will inflict higher time costs on other trains in the system, and the total SRMC-prices will not be visible before the final timetable is elaborated. For practical purposes this connection between time costs and slot allocation needs to be simplified.

One method that can be used, is to define some categories, for which the external costs are treated as constant. As a few categories are needed for accident costs as well as environmental costs and time costs, there will exist multiple combinations of cost parameters and thus multiple levels of external cost payments (see WP6). It is important that the number of cost parameters do not make the slot allocation procedure too hard to compute. Given these categories, the operators as well as the infrastructure manager knows in advance the level of external cost pricing for any given train.

Assuming that the infrastructure access charge is correctly set so that the external costs in the actual market that has been created through some kind of slot allocation procedure, all revenues from the slot allocation procedure will be a transfer from the railway sector to the government. This will lower the producer's surplus and therefore reduce the operators' profitability. In an auction procedure with many operators competing for slots, the revenues from the slot allocation procedure might be substantial. It can be questioned whether this is problematic or not. Higher costs for the operators will normally lead to reduced activity, since the demand curve is downward sloping. This reduced activity can lead to reduced frequency of trains but at the same time increase the average speed of the trains in case of congestion. So the outcome of this is uncertain.

In standard microeconomics a transfer between the private companies and public is neutral. This idea is often questioned by setting a cost on tax money.

The revenues from the slot allocation can be invested in the railways, or transferred back to the operators or the passengers through some subsidies. Private investments in the rail operating market depend on the expectation of profitability. An expensive auctioning round reducing the producers surplus dramatically, can effectively hinder private investors to enter the market. Barriers to entry e.g. by high investments costs increases the need for high profitability before potential operators are willing to enter the market (see discussion note for more on this topic).

Auctioning of track access rights seems more and more reasonable as the number of operators increases. With just a few bidders there is a risk of speculative cooperation. If auctioning is presented in multiple markets where a few big companies compete against each other regularly, there is a risk of agreements between the companies where the markets are divided between them, and thus the competition is destroyed. Some researchers suspect this to be the case in some aviation and bus markets. Cooperation may also be caused by economies of density and is therefore not always a negative property of a market. Another reason why there tend to be few competitors in such markets, is an economy of scale. In that case this trend can be regarded as the result of well-functioning markets.

In the Nordic countries, and probably for many other European countries with medium or low population density, a situation with multiple operators in the passenger transport market seems highly unlikely. A situation of one to three operators seems more plausible. It is important that the slot allocation procedure can handle such a competition with few competitors. There are experiences from other sectors that can

lead us to questioning the feasibility of an auctioning system. Learning from these experiences, should at least make us more prepared for finding good and feasible solutions.

5.2.4 Different ways of allocate track capacity between operators

This section will analyse how track can be allocated between different operators by setting an access price on the track.

Following the earlier works of Dupuis and Pigou, Walters (1968) is among the first to show that rationing access to roads (or infrastructure in general) experiencing congestion can be welfare enhancing. The principle of access pricing is easy to understand. In congested situations there is no way to separate urgent traffic (except for emergency cars and lanes for public transport), from the weekend-motorist. A congestion charge, making the traffic travelling during peaks of the day paying a higher price, can do just this. This will reduce traffic jams, and spread traffic more evenly across time. The EU-commission has made several reports indicating that they see this as the future solution to cope with growing congestion around the major European cities.

For roads this principle is called road pricing, and can be seen as a real-time traffic control problem. The prices are dependent on the road and time of the day. For aviation or railroad, the number of vehicles is much less, and the infrastructure is limited to serve one or a few vehicles at the same time. The access to a specific part of the infrastructure - a block at a special point in time - is called a slot. The operators have a different willingness to pay for different slots, varying with the underlying demand function of the passengers and the characteristics of the operators. For traffic running according to a timetable, real time pricing is impossible (as explained above). The slot pricing must be done in advance during the setting of the timetable.

Supply is closely related to blocks. Supply can be increased either by making the blocks shorter e.g. by building new meeting stations or by making more blocks by building additional tracks, or by improved control and signalling installations.

Demand is derived from the underlying demand for passenger and freight transport. Generally, demand is strongly varying over the day, and this will make the value of different slots very different. There might be a peak at 1600 in the afternoon, but at 1545 and 1615 the passengers' total willingness to pay (WTP) might be lower. For freight the cost of expediting or postpone a departure will be regularly much lower as the value function shown in figure 4 and figure 5 is flatter.

Complementarities in demand for track allocation might be very high. That is, the value of a slot from B to C is much higher if a train from A to B arrives a few minutes earlier. Both lines do not need to be run by the same operator, but the trains needs to be coordinated in a way so that journeys using more than one train have their waiting time minimised (obviously, there is a trade-off between waiting time and reliability: too little time between arrival and departure results in loss of connection when there is deviation from schedule.) The operators may also want to exclude other operators from being to close to their trains, that is, to reduce the risk of interference with delays that occurred to trains close to their own. If we let the operators bid for this time and space around their trains we will get the value of this risk incorporated in the market. But, it is important to be aware of the option of predatory behaviour that this possibility incurs.

The original way to allocate track was by a railway company in charge of the infrastructure as well as of all trains using the infrastructure.

In a market for multiple operators, the timetabling procedure needs to be done by an independent body. The separation of infrastructure and operators in EU-directive 91/440 is a way to arrange for such a timetabling body. Such a body can perhaps be a good way to allocate track in a market with very few competitors. Arranging for a meeting with the operators and the public authorities that specifies requests for certain routes at certain periods, might be sufficient to reach an agreement ending up in a timetable accepted by all parties. There is a risk that the timetable in such a procedure is sub-optimal and that the decision –making is biased. This could be in favour of the major company, or the company with the best

negotiator, or the company that is most pleased by a few changes in the timetable, since such agreements tends to be quite conservative.

In a multi-operator market a well-functioning market for slots seems to be the best solution. Tendering is widely used for many modes of transport. There are many forms of contracts that can be tendered. Some contracts are fixed, but other can be adjusted in many different variables. So there is no clear distinction between tendering and auctioning.

Auctioning procedures have been studied in many different markets, but there is not very much actual use of the method. More use of auctions is expected in the future. There are some negative experiences with auctions. Especially in the mobile phone market, where the licenses for 3rd generation network led to prices far over what (now) seems to be reasonable. In the public transport there are examples of division of the market into sectors by the operators to reduce competition.

Auctioning seems to be the most promising method in an advanced market, where there are many parameters that can vary and many pitfalls that eliminate the advantage of this method.

5.2.5 Some different auction methods

Some different auction methods are described briefly in this chapter. For the evaluation of different methods a few concepts should be presented.

The most important differences of auctioning procedures are

- *Number of auctioning rounds (single round, two rounds, .., multiple rounds)*
- *In what order the objects are auctioned. (sequentially or simultaneously)*

Auctions with one round are often referred to as “closed bid auctions”. Tendering procedures are often in this form.

Multi-round auctions open up for raising bids over the highest bid from the previous round.

One method has been referred to as “English auction”. This is a form where the bids are stated orally in an auction premises, and where the bidder is free to raise his/ her bid upwards.

Another method is often referred to as “Dutch auction”. In this procedure the seller of the object (e.g. slot) announces a price and the price is lowered until some buyer accepts the price.

These methods are of the form where the winner pays the winning bet. Vickrey-auctions are another form of auction where the one that has stated the highest bid wins, but actually needs to pay the second-highest bid.

For allocation of slots in the railway sector Brewer and Plott (1996) introduced an auctioning mechanism called BICAP. In a BICAP auction any potential operator can bid on one or more licenses in a continuous time auction. The highest bid cancels out the lower, and the allocation of slots that maximises the auction revenue at any point in time is prevailing slots. The auction is over when a predetermined period has elapsed with no new bids.

There are many other auction forms that can be analysed. See e.g. Milgrom (1989) and McAfee & McMillan (1987).

In the evaluation process of such bids the concept of “**auction efficiency**” can be helpful Auction efficiency can be assessed by the function below

$$\frac{\sum_{i=1}^{I} V^i\left(\hat{y}^i\right)}{\max \sum_{i=1}^{I} V^i\left(y_1^i,\ldots,y_n^i\right)}$$

In this general equation there are n objects $y_1,...,y_n$ that are allocated between 'i agents. Agent j's valuation of the objects is given by the value function $V^j\left(y_1^j,..,y_n^j\right)$. Here $y_k^i = 1$ if and only if operator i wins the auction for object k. The denominator is the maximum value that can retrieved by any allocation. $\hat{y}_1,...,\hat{y}_n$ is the real allocation from the auction.

Time needed to undertake the auction might be causing the bidders great costs. There can be a trade-off between time-consuming auction procedures and auction efficiency.

5.2.6 A Model for Slot Allocation

In a liberalised railway market, there is a need to allocate the scarce infrastructure between the operators. Slot allocation can be done in several ways. Obviously, one solution is to let some committee of qualified personnel do the allocation. This has some advantages, in the way that knowledge of experienced persons can be used actively. Unfortunately, this might also reveal the limitations of the human mind, as this system probably will be too conservative in changing the existing system.

Possible connections to the old companies may result in biased decision making. Another way is to create a market for the infrastructure where the operators are invited to compete in a fair market. Different ways of doing this suggested by (Grether & al, 1989) are secret bids where the lowest accepted bid wins, or to distribute slots randomly and then let the slots be traded in a second hand market. It can be questioned if this might be too demanding for the operators. Another problem is that the operators cannot trade for the parameters set in the slots (e.g. risk premium by buying a "broader" slot), as we will explain later, this can be included in another auctioning system suggested by Nilsson (1998). We will concentrate on this theory and analyse its implications in the following.

Two step optimisation problem

Nilsson's method can be roughly explained as follows:

- First, reveal operators' true WTP for all slots. The bids will need to be some kind of distribution for WTP for departures near the requested points in time. A typical freight train may be illustrated by a quite broad value function, while a passenger train probably will have a higher sensitivity to time variations.
- Second, find the optimal composition of slots, i.e. the combination that maximises the social benefit.

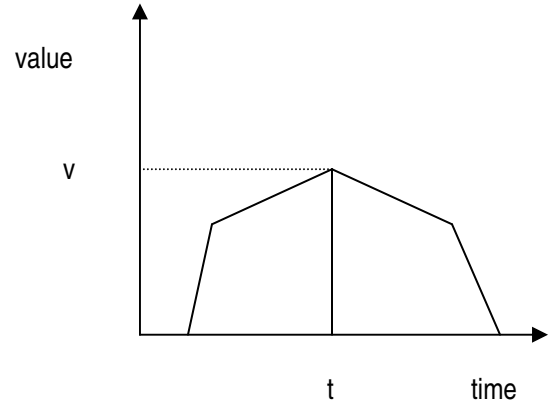
The solution of the first problem is some kind of auction. The solution of the second problem is some kind of software that uses a mathematical optimisation technique. This ensures a non-discriminatory and correct optimisation. We will analyse these problems separately.

5.2.7 How to reveal the operators' true WTPs for slots

The first problem is basically related to how to reveal the operators' WTP in a situation where the operators have incentives to cheat. By claiming that a train is more valuable than what is true, there is a possibility that this train excludes a train with a higher actual value. This forces a technique to reveal the true value that minimise or even eliminate the incentives to cheat. Nilsson (1999 and 2000) elaborates more thoroughly what is described in this section.

Figure 4 and 5 exemplifies operators' true valuation of two slots. The function is called a value function and not a WTP-function since there can be differences between true valuation and revealed willingness to pay. WTP can be influenced by e.g. strategic behaviour or mark-ups, whereas the value functions indicate the actual underlying valuation of a slot.

Figure 4. Valuation of slot for passenger train



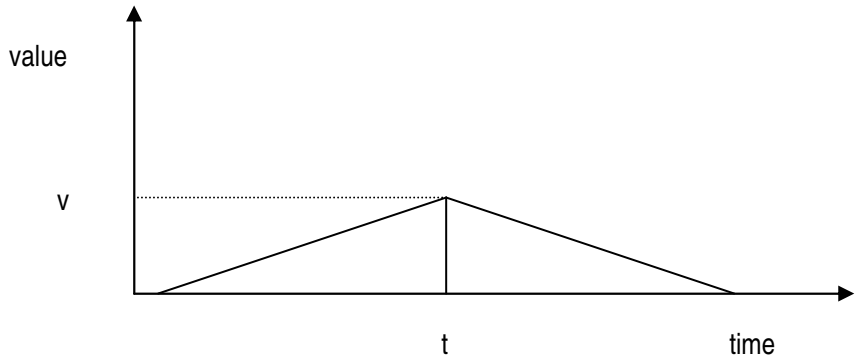


Figure 5. Valuation of slot for freight train

We see that the valuation is distributed around a maximum point. The operator has a maximum value v of getting the departure exactly at t. For points in time near t, the value is lower but positive. Figure 4 will typically be a passenger train, while figure 5, which has lower maximum value and less sensitivity for deviations in time will typically be a freight train.

Let us now imagine that we are responsible for designing a new timetable. What we have is the infrastructure including signalling, terminals etc. and some laws and regulations ensuring the security level. In the old system with basically one operator, the timetable-designers could take all rolling stock into considerations along with knowledge of the demand structures as the railway company had yearlong experience. In the new system, this is no longer possible. Newcomers in the market must be treated on an non-discriminatory foundation, and the rolling stock, demand structures and products involved in a modern railway system is far too complex to be regulated by some central authority alone. Then we will have to create a market where most or preferably all aspects can be reflected in the pricing mechanism. Auctioning access to the track is a way to actually manage this.

An auction is a way to distribute track capacity among operators, according to stated willingness to pay (WTP) through bids. This is an efficient way to allocate track access, since the operator with the higher producer surplus can pay a higher price for a slot than the others. The operators will have some insights in the demand structure, and are now invited to bid for slots. These bids need to include some characteristics like all stations that will be served, times of arrival and departure, that is, an assessment of the speed. This

is relevant, since as we have seen the timetabling is seriously affected by differences in speed between trains. The operator may want to pay for a reduction in risk for delays by buying some broader time interval than necessary to reduce the risk of delays induced by other trains. Where old-fashioned time-tabling will be very conservative with respect to radical changes in the timetable, an auctioning system might provide timetables that differ significantly from the old ones, and thus be much more capable of adapting to changes in both supply and demand.

True WTP

We want to design a system that reduces the operators' incentives for not revealing their true WTP. The problem occurs when the bidders try to exclude other bidders by setting the bids too high, or pinch the best slots by exaggerating their WTP, knowing that they will not need to pay this price or by cross-subsidising these routes with other where the producer surplus is positive. The situation where one operator wants to exclude another operator from the market by setting very high bids, is often referred to as predatory pricing. When the operators do this, or believe that other operators may do this, we will not have a fair and efficient allocation of track capacity.

There have been multiple studies on the topic of auctions on infrastructure capacity. Not only for railways, as this problem also has a counterpart in for example the cell phone market and the aviation industry.

Vickrey auctions (Vickrey 1961) is a way to avoid speculation in the bidding process. Vickrey showed that with a simple auction rule the dominant strategies of the bidders would be to reveal their true WTP. The main point is that the auction shall be won by the one setting the highest bid, but the winner shall actually pay the second highest bid. This simple rule can be applied, to reduce the risk of harmful strategies where e.g. a dominant bidder pushes competing bidders out of their potential markets. The use of multiple Vickrey auctions is suggested by Nilsson (Nilsson1999).

The infrastructure manager receives the first bids for the slots and runs some automatic timetable procedure. The result is then sent back to the operators who can adjust their bids. The infrastructure manager runs the timetable procedure again, and the operators adjust their bids until nobody wants to change their bidding. This is then the final timetable.

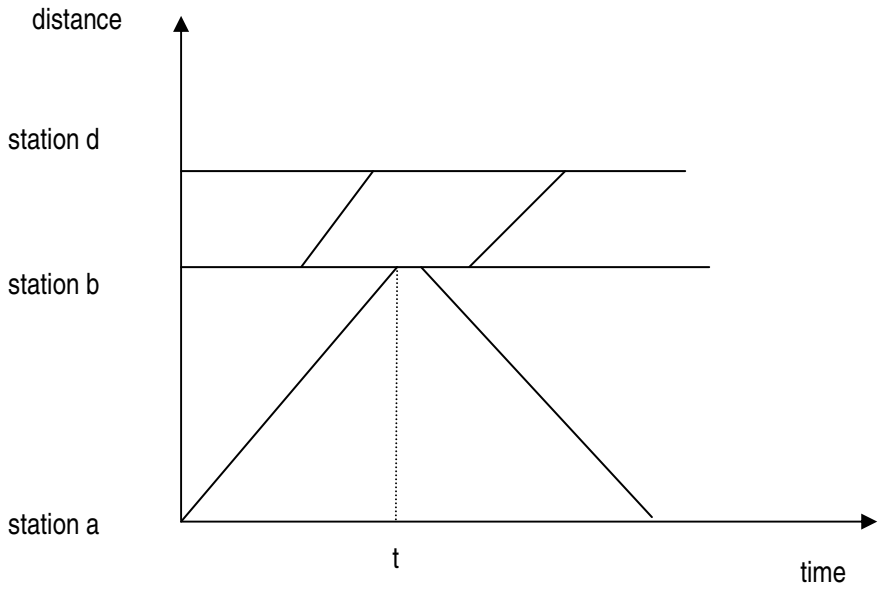
The timetabling objective function is then to maximise the WTP from the operators, given the limitations of the capacity of the tracks. Another condition that must be held is that the accepted bids must not be lower than the SRMC in the actual market. How this is done is by setting up the SRMC-prices in advance. The SRMC-pricing principle will typically consist of a few subdivisions like freight, passenger, electricity and diesel as well as some division of time and track according to (expected) density on track. Given these prices the operators will know the admission fee to the market, and the actual bids will be prices above SRMC. Operators unwilling to pay the SRMC will simply not be granted access to the track.

5.2.8 Dealing with complementarities in the bidding process

If we take a look at the figure below we see that the train leaving station a arrives at station b at time t. We see that there are two trains leaving from station b to a third station (d). The departure leaving after the arrival of the train from station a, will of course be of a greater value as the travellers leaving from station a to station d will be able to combine these two train departures without much waiting time. The value of the slot from a to b and from b to d will probably both increase if the departures are coordinated to match each other. Off course, different operators can run the trains. The question is how to consider these complementarities in the slot allocation process. The most straightforward way is probably to let the operators bid for a whole package of slots. The extra value of the complementarities will make these bids beat the bids for any slot on its own as long as the operators correctly assess the benefits of complementary slots

In practice, we are afraid that this is not yet achievable. This is an advanced topic, and an important property of the railways. Through research along further development of market mechanisms, new ways of dealing with this issue is likely to be found.

Figure 6 Example of complementarity in the market for slots



5.2.9 Designing the timetable

As explained earlier the operators' bids are run through an optimisation process, which finds the optimal timetable given the stated preferences from the bidding process. This optimisation process can also be done with "packages" of slots. The timetabling objective function is simply to maximise the payments through the bids, given the limitations of the capacity of the tracks. This will ensure that the most profitable routes will be included in the timetables. This gives correct incentives for cost-minimisation and exploitation of the WTP for railway services in the market.

Condition that needs to be taken into account:

- SRMC-prices. Accepted bids must not be lower than the SRMC-rule determined for the infrastructure access charge. Given these prices the operators will know the admission fee to the market, and the actual bids will be prices above SRMC. Operators not willing to pay the SRMC will simply not be granted access to the track.
- Pricing of risk. The operators can be given the possibility to pay for reduced risk for delays by buying "broad" slots, where there is more than the minimal required space around the train on the track, so that delays in the system will less likely affect this train. This will arrange for high-quality trains in the market. This might enlarge the railway market as passengers with high WTP and high value of time, will choose the railway instead of other modes of transport.
- "Packages of slots" in order to internalise complementarities.

- Barriers to entry. If financial or juridical obstacles are effectively hindering competition in the railway market, the foundation for well-functioning markets may be ruined. This demands that the authorities take some actions to reduce/ remove the barriers through regulations and interventions.

A tricky question in the auctioning system is how to secure some minimum level of transportation in all areas and all relevant times of the day. There can be multiple solutions of this problem. Much research is done also on this topic, and different ways to handle this issue have been suggested. Normally, some public authorities will secure some minimum level of supply of railway services. The operators are then given money transfers from the authorities for these services.

Conditions that do not need to be taken into account:

The operators must comply with certain demands in order to enter the railway market. Once these requirements are met however, there is no need to take these elements into account in the actual auctioning process. Examples are:

- Financial requirements
- Safety requirements
- Technical requirements

5.3 Current practice in slot allocation

Slot allocation pricing should price rail infrastructure capacity in a transparent, efficient and non-discriminatory way. This requires international transparency with respect to infrastructure tariffs and results of access price negotiations. The pricing systems proposed by European Commission (Directive 2001/14) for infrastructure usage are based on the 'user pays' principle and should realize fair competition. Environmental, congestion and accident costs should be embedded within these charges.

5.3.1 Theoretical considerations regarding allocation of capacity in railway systems

As previously seen, Slot allocation has been applied in air traffic for decades as an effective management tool, maximising capacity usage and ensuring good utilisation of the available resources, though considering that some flaws do exist. These have however been subject to analysis while reviews in order to cope with the changing environment may be adopted. It is worth noting however that pricing has not been an element in the slot allocation procedure.

Unless railway infrastructure managers offer seamless, end-to-end services to customers, it won't be possible for Railways to become competitive with other modes. The railway reforms must therefore aim at meeting the demands of the market and the client. Since equity issues are a major concern, it is essential to define a fair, non-discriminatory set of regulations when it comes to dividing the available capacity in railways. In the context of IMPROVERAIL, it is interesting to see which lessons may be drawn from slot allocation process in Air Transport.

However, it must not be forgotten that a delayed plane imposes far less problems onto another plane, simply because one plane can easily overtake another.

The national level is not necessarily the most relevant level for discussing rail transport, particularly freight transport. For the latter, the issues and markets are European. In fact, more than 50 per cent of the freight revenues of DB and SNCF are from international traffic. Infrastructure access charges should also send the right signals to the infrastructure owner concerning the need for investment on certain heavily used sections, in order to reduce congestion on rail infrastructure. The pricing mechanism should also promote efficient allocation of train paths among different users. It should be said that, until now, where infrastructure has been separated from operation - notably in the United Kingdom - infrastructure access charges have not been found to provide the right signals and have undergone several major changes Getting the prices right is not a simple task.

Risk for delays

Delays are a major cause for concern among infrastructure managers, especially in the context of slot allocation. If one train is delayed, most of the times it will impose another delay onto other trains. If that other train belongs to a different operator, then how will responsibilities, priorities and penalties be dealt with?

The risk for delays can be reduced by bigger time margins; this is, however, in conflict with the desire for maximising capacity on congested infrastructure. And some delays are simply unavoidable. Can operators or infrastructure managers be held liable for the delays that they caused?

Penalty systems could be applied, but determining how much damage is caused by a delay is very difficult; the time of the delay is a factor but also the number of trains affected by the delay, and to what extent is the delay to blame on one operator?

One could implement a penalty system where the operator at fault would have to pay a particular compensation to the affected operator for every minute of delay per affected train, of course only if a delay can be traced down beyond doubt to one operator. Such a system is currently used in the United Kingdom. Besides, passengers could be entitled to get refunds from the operator in case of considerable delays; this system is already used in the Netherlands, for example. Government enforcement of such a refund combined with the above-mentioned system of compensation between operators would create a very strong incentive for operators to provide high-reliability operation. Consequently, similar penalties could be demanded from the infrastructure managing body if it is to blame for particular delays.

Varying WTP for different slots and Peak/Off-Peak pricing

The Willingness-To-Pay (WTP) describes how much a slot is really worth to an operator. The WTP is a key management element since it reveals the value of a particular slot to a train operator. But how does a railway infrastructure manager measure or even estimate the WTP of the different operators?

Obviously, the willingness to pay (WTP) varies considerably between peak and off-peak periods, and also between congested and low traffic density lines. One way to ensure an acceptable level of service, can be to reduce the prices of the off-peak period and on low-density lines, possibly even to a negative amount. Another way to do essentially the same, would be to directly subsidise the operator that is willing to run an unprofitable line and not differentiate the slot price with time or place. The second option would be to let the operators bid on packages of slots/train paths; in this way the regulator can have more influence on the total service level. In this option there would be no, or less, price differentiation between the different slots. In every case, auctions are an effective way of revealing the true WTP of the operators.

Different treatment of freight and passenger transport

The main difference between passenger and freight transport is that passenger transport is subject to Public Service Obligations (PSOs). Freight transport on the other hand does not have the public service aspect. As a consequence, slot allocation and pricing mechanisms of freight transport can be more simple and straightforward. The WTP for a slot is not so time-dependent and at night there is plenty of spare capacity on most railway networks. As shown in the Dutch example, there are already regulations in force stipulating that passenger traffic will have priority during the peak hours:

- Priority for goods transport on the rail network in the early hours. The capacity for passenger transport will be restricted to a minimum level to be specified,
- Priority for passenger transport in the rush hours. In the rush-hours, goods transport will be limited to a minimum level,
- In the off-peak hours, passenger transport has a slight priority.

Objectives of the train operator regarding slot allocation

TOCs will try to gain maximum flexibility, and the best slots, for the lowest possible price. In order to gain or maintain market dominance, it can be beneficial for the TOC to acquire even more slots than it probably needs, and then leave the surplus unused, just to bar new parties from entering the market. Another aspect is that the operator needs to have a long contract time in order to make investments in rolling stock worthwhile. Leasing companies (such ILFC in the aviation industry) that lease rolling stock would reduce the need for that, but such companies are still not available at the moment in Continental Europe. One single European standard for traction voltage, signalling and train dimensioning would make the market for train leasing much bigger and more viable.

5.3.2 Supply Side – Review of current and best practices for slot allocation/ pricing procedures

The current practice of railway infrastructure charging in many countries was outlined above. A practical overview of the situation for each country, is presented below which summarises what is described in greater detail along this subchapter, including flowcharts allowing a better understanding on the procedures related to the allocation of capacity :

Table 5: Summary of slot allocation practices throughout Europe

COUNTRY	VERTICAL SEPARATION	# OF OPERATORS	RESPONSIBLE FOR SLOT ALLOCATION	SLOT ALLOCATION PROCEDURE
BULGARIA	Yes	1	Independent government body	Negotiations
FRANCE	Incomplete	5	Semi-independent body	
GERMANY	Yes	18	Independent government body	Negotiations Auction
GREECE	Accounts only	1	State Railways	None
ITALY	Yes	4	Independent government body	
NETHERLANDS	Yes	7	Independent government body	Negotiations Ruling or auction
NORWAY	Yes	2	Infrastructure manager	Negotiations
PORTUGAL	Yes	2	Independent government body	-
UK	Yes	36	Independent shareholder company[1)]	Negotiations or ruling

Source: Country Reports

5.3.3 Report on Member States Practices

The following boxes summarise slot allocation procedures in a set of countries, explaining the process of capacity allocation:

FRANCE

Vertical separation between the Infrastructure Manager, Réseau Ferré de France (RFF), and the operator SNCF has not been completed yet, in the sense that capacity planning is still done by the operator, since the IM has insufficient resources and information. Efforts to establish an independent regulating body have so far met huge resistance from SNCF; that is why this establishment is merely a medium- to long-term goal, considering SNCF's political influences.

When a new slot is required, SNCF tries to insert the new train in the circulation chart. Implicitly, priority is given to trains that were circulating before this new slot was required. The outcome of a request for a new circulation may be one of the following three possibilities:

- The new slot can be inserted without any difficulty. The access right is granted;
- Some difficulties arise, in which case some adjustments are considered and alternative proposals are presented to the operators. If necessary a priority is given to operators for which the infrastructure was built (i.e. mainly SNCF) or operators operating under public service contract with the central government or local authorities. At the end of the process, a slot is proposed, not necessarily the requested slot.
- Access is denied. However, the transport ministry keeps the right to deliver some special slot rights when:

    - It is necessary for the public service;
    - It is useful for an efficient utilisation of infrastructure, or;
    - It is helpful to finance new lines or improvement of existing lines.

NORWAY:

The Norwegian railways (NSB) implemented an account separation in 1990. An independent government body, Jernbaneverket, was established 1996 to manage the railway infrastructure.

Jernbaneverket determines timetables. The traffic ministry decides, after consulting all parties involved, on the allocation of train paths in the event of changes to the timetable. If the operating companies and the Jernbaneverket fail to reach agreement, existing traffic may be given priority in case of a change in the timetable.

On a non-discriminatory basis and within the framework of the regulations, Jernbaneverket may lay down rules for the allocation of the train paths. Such rules shall be announced no later than at the start of the next timetable adjustment.

In the event of routing changes the following rail services shall be given priority:

- Services provided in the interest of the public, as defined in Regulation (EEC) No 1191/69 of 26 June 1969.
- Service wholly or partly operated on infrastructure for certain specific service (high-speed lines or specialised freight lines).

The ministry has sold priority rights for a period of 30 years to Flytoget AS (the Airport Express Train) on the Gardermo-line. In the agreement the opportunity is created for new companies to bid for such a priority.

THE NETHERLANDS:

In the Netherlands currently there is a large passenger train operator (NSR) serving most of the national network, some regional companies operating passenger trains on low-intensity branch lines, and three competing freight companies. Slot allocation is the responsibility of two independent government bodies, Railned and Railverkeersleiding (Rail Traffic Control). The latter deals only with last-minute allocation and handling of completed schedules. It is expected that the two bodies, as well as Railinfrabeheer (the government body responsible for track engineering), will merge into one single governmental infrastructure manager.

The different slot allocation procedures are straight-forward, and are divided into three phases:

1. Allocation through a standard hour pattern (clock-face timetable)

Train paths that repeat in an hourly pattern will be allocated to passenger and freight train operators. If the requests of the various operators are incompatible, operators will be asked to adjust their request in order to solve the incompatibility. If this still doesn't lead to a desirable result, the allocation will be done at the discretion of Railned, using the allocation rules mentioned below.

2. Allocation on a daily pattern

In this phase, the paths and slots remaining after the hourly pattern allocation can be distributed on a daily pattern if requested. Incompatibility procedures are the same as in the first phase.

3. Allocation by date

The final phase allows operators to request railway capacity for particular dates. Spare capacity must remain for last-minute (re)scheduling.

There is a hierarchical order between the phases: once an earlier phase has been approved, it will act as a fixed constraint in later phases. This gives passenger traffic a large advantage, since freight traffic is unlikely to operate on an hourly pattern.

Allocation rules:

The following priority rules apply if operators have submitted incompatible requests following consultation:

- At junctions with the conventional network, international transport over the high-speed lines has firm priority over other passenger transport;
- International transport not running on the high-speed line has the same priority as train services on the main rail network;
- At junctions with the conventional network, domestic high-speed transport has just the same priority as transport on the main rail network. Should capacity conflicts arise between these segments which cannot be resolved through consultation, the capacity allocation agency (Railned) will decide on the basis of estimated advantages for the passenger based on criteria resulting from legislation;
- Transport on the main rail network has firm priority over regional transport, but regional transport does have the right to a minimum capacity and quality;
- Regional transport has slight priority for the number of train services as laid down in the capacity allocation policy framework and in the franchising conditions;
- Charter transport gets access to remaining capacity.

If operators form the same market segment have a conflict regarding the capacity to be allocated, priority rules cannot be applied directly. Consultations between applicants and, in the case of goods transport, in extreme cases, sale by auction, is the recommended way.

United Kingdom:

The United Kingdom uses an infrastructure charging mechanism in which operators that do not respect their allocated slots are penalised; so that congestion costs for other users are to some extent covered.

The way the slot allocation process works is described here.

A. Slot Allocation Process for FOC's

i. The received request is scrutinised under the Slot Analysis Process.

ii. If there is a competing bid or bids they are passed to the Arbitration Procedure for a decision.

iii. If the request is rejected by the Slot Analysis Process, the FOC may challenge the decision via appeal, triggering the Arbitration Procedure.

iv. If the rejection is not appealed, the slot allocation ceases.

v. Approved slots are passed on to the Operations Planning Process and the Charging Process.

B. Slot Analysis Process

i. The Slot request information is passed through a number of "tests" that filter for bids that Railtrack will have to reject.

ii. The first filter for request comparison is against route characteristics. Can the track accommodate

the train and consist proposed? Is the route electrified? Additionally it is at this point that it is determined whether the slot is currently free (and therefore a valid request).

iii. The second filter is for capacity constraints - these are a combination of the route's physical characteristics (e.g. maximum line speed) and the traffic type(s) using the route.

iv. The third filter is for performance risk - will awarding the slot seriously and adversely affect other operators? What risk is posed to e.g. passenger services should the fright service be late or suffer mechanical failure?

v. If there are competing bids (and two or more bids successfully pass the filters) the arbitration procedure determines the successful operator.

vi. The Slot is approved and the details passed on.

C. The Arbitration Procedure

i. If Railtrack rejects a request for a slot the FOC may appeal that decision.

ii. If it decides to do so, the Strategic Rail Authority (SRA) evaluates the request and Railtrack's reasons for rejecting it.

iii. If the SRA upholds Railtrack's decision, the process ends.

iv. If the SRA overrules Railtrack the slot is awarded and the process continues as would a successful request.

v. Alternatively competing bids can be received for the same slot. In this case once again the SRA determines the successful bidder, who proceeds, and all unsuccessful bids terminate.

GERMANY:

DB Netz performs the role of slot allocation agency in Germany. The slot allocation procedure consists of the following steps:

A. General

In order to apply for a slot, the operator must apply before a deadline, determined by DB Netz. The deadline is related to the date of the timetable change.

B. Application

The operator must apply for slots using sufficient technical data, as well as the time for which it requests capacity. Submitted requests are considered definitive, any changes after the deadline risk being denied.

C. Train path construction

While constructing the train paths, the following priority rules are considered:

Applications before the deadline above applications after the deadline,

Previously used paths above new applications,

Applications that, at the time of the application deadline, already comply with the technical/logistical requirements (as published by DB Netz) for particular lines, above non-compliant requests,

Applications for path patterns that, due to their regularity, enable a higher infrastructure utility above irregular or on-demand services,

Applications for paths that last through several timetable periods above those that last for only one timetable period or less.

***D.* Planning conflict**

In case the path applications of different operators clash, DB Netz will immediately inform the operators concerned and give them suggestions for a solution. A new deadline is set, until which the planning for that particular stretch of railway is suspended. The operators can suggest modifications to the timetable until this deadline.

E. Conflict-solving discussions

In case a planning conflict cannot be solved in the way described above, DB Netz organises discussions with the operators involved, in order to seek alternative ways to a solution. Some of these discussions can also be held using local allocation criteria.

F. Auctions

Finally, if discussions lead to no result, train paths will be auctioned. Each bidding operator must offer a price higher than the default track price and the highest bid wins.

G. *Denial of applications*

If paths cannot be realised during the initial allocation or the discussions, and if the operator loses the auction, the application will be turned down.

H. Contract offer

When the negotiations have successfully finished, DB Netz makes a final offer that stands for one month. If the operator does not respond to the offer, DB Netz reserves the right to withdraw the offer and allocate capacity to other operators.

I. Non-regular traffic

Slots for occasional traffic can be requested some time ahead; they can be included in the timetable if sufficient capacity is available.

J. Timetable modifications

Operators may alter their timetables within the timetable period provided that other operators are not affected. DB Netz may claim any costs arising from this change.

K. No-show and cancellation

When the operator cancels paths either before or after the start of the timetable period, the operators may still be charged for them.

BULGARIA:

The Bulgarian railway infrastructure is settled by the National Company "Railway Infrastructure" (NCRI), established in 1995. The slot allocation procedure is as follows:

- NCRI provides slots to any certified operator upon request;
- In case the slot is not allocated the deprived operator can appeal against NCRI's decision using internationally standardised procedures.

Currently, Bulgaria has only one operator, Bulgarian State Railways (BSR).

PORTUGAL:

The Portuguese railway infrastructure manager, REFER (Rede Ferroviária Nacional, EP), was created in 1997 . Since 1999, a new railway operator - Fertagus - operates suburban trains besides CP, the national operator. These two operators share part of the 20 km link used by FERTAGUS. Each year with the production of the timetables, slot allocation coordination is required to conciliate the FERTAGUS and CP requirements. In the shared section, CP operates suburban trains that use the North Line (the most important line in Portugal) and therefore imply constraints in other CP services. With the extension of the lines used by FERTAGUS, the sharing of capacity will increase.

GREECE:

The Greek railway infrastructure is managed by OSE, which is also the only operator. Vertical separation is limited to accounts only. Given the fact that Greece has only one operator, and that train frequency is low, slot allocation is currently not an issue.

5.3.4 International slot allocation in railways: RailNetEurope

On September 24th 2002, eighteen infrastructure providers signed the RailNetEurope treaty, which offers international train paths in sixteen countries through one single organisation. The treaty went into effect immediately. RailNetEurope is the result of an international project called Trans-European Rail Freight Network (TERFN).

The concept of TERFN originated with the EU Commission, which spelt out basic ideas in the papers "A Strategy for Revitalising the Community's Railways" (COM 96/421) and "Trans-European Rail Freight Freeways" (COM 97/242).

By this concept, Railway infrastructure providers were to form a consortium for the purpose of selling fast timetable paths along a railways freight corridor at a commercial price to any licensed freight train operator. These sales would be through a single source, referred to as the "one-stop shop".

The aim of the TERFN concept was to overcome some of the well-publicised shortcomings of traditional railway freight operations on a European scale such as:

- Liberalisation of access rights created by Directives 91/440/EEC and 95/18/EC had not been fully exploited due both to certain barriers to entry and an incomplete legislative framework;
- reliability and punctuality of railway freight movements in Europe were considered to fall short of what customers wanted and what could technically be achieved;
- average commercial speeds in the order of 20 km/h for certain door-to-door railway freight services were considered inadequate;
- the problem of technical and commercial fragmentation along the national boundaries of the existing traditional railway systems had proven limiting to true competition and an to aggressive tackling of the need to increase the modal share of rail in long distance freight movements in Europe.

The first Freight Freeways between Antwerp, Belgium and Gioia Tauro in Southern Italy (2 427 km) became operational in January 1998, being based on an agreement signed between SNCB, CFL, FS and RFF in November 1997, initially providing for 17 paths. Later, it was extended by incorporating RENFE, to Valencia and Barcelona, offering a total of 25 paths along 3 825 km as of 2000. Figure 3 shows the international train paths that are offered so far.

So far results have been disappointing since users of the TERFN were the existing state railway companies in the form of a grouping of their freight divisions running trains in the conventional way.

On the positive side, the TERFN has clarified the technical and commercial characteristics of what the combined systems can offer under the existing structures. This relates to specification elements such as average commercial on-rail speeds (values in brackets are for the Belgium-Italy path):

- speeds: these are typically 45-55 km/h
- allowed length of through trains (400-700 m)
- electric traction systems (3)
- allowed loading gauges (PC 70/400, C 70-390, PC 32/341, etc.) for through trains.

Slot allocation is often hindered by the fact that train paths on national borders do not match, which in turn might make a path less interesting to bid on or request for by a train operator. The fact that the operator has to deal with more than one Infrastructure Manager, more than one slot allocation system and sometimes non-matching train paths is an obstacle for the running and developing of international train services.

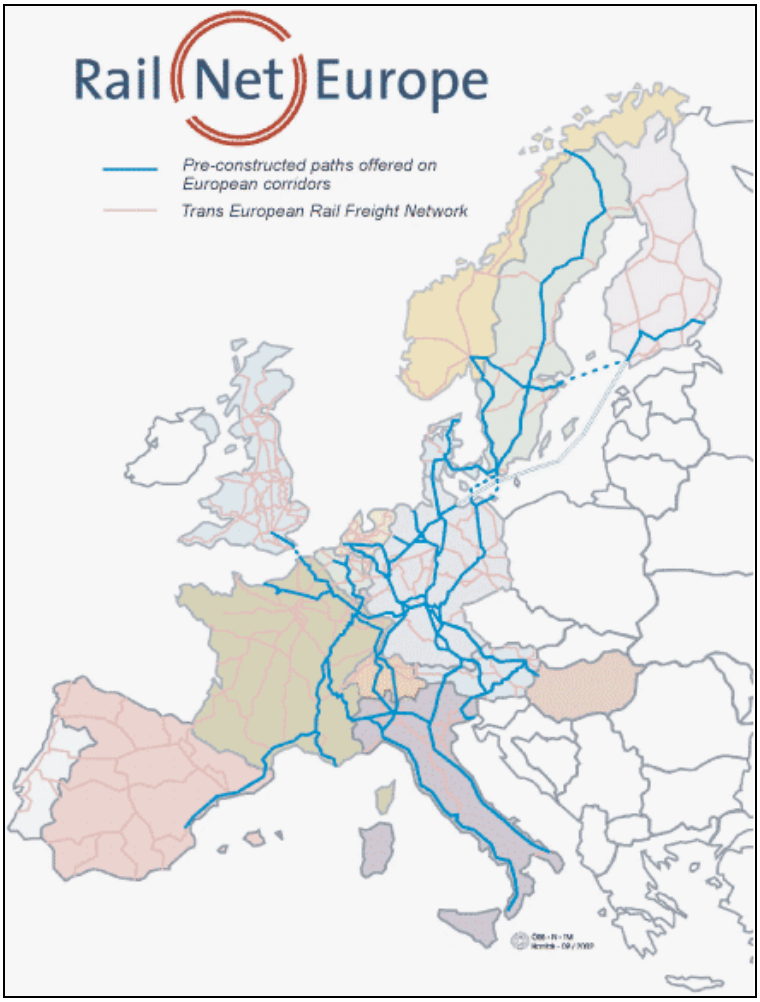


Figure 3: International train paths offered through RailNetEurope.

Since 1998, an organisation called Freight Freeways has been selling international train paths for cargo trains on the main North-South axes in Europe (e.g. Rotterdam-Italy, Hamburg-Scandinavia, Rotterdam-Vienna and others). It was a joint initiative of the European Infrastructure Managers and the main objective of the initiative at the time of inception was to test open access for international rail freight traffic. On the 24th of September 2002, it changed into RailNetEurope, with the participation of infrastructure managers from all EU countries except Ireland and Greece, plus Norway, Switzerland and a part of Hungary.

One Stop Shops

RailNetEurope offers cargo operators the possibility to book infrastructure capacity across national borders, and they have to deal with only one institution, the so-called “one-stop shop” principle. This simplifies the work for freight operators considerably, since they can book capacity at only one “desk”. Booking happens through local offices, one in each participating country. Timesavings in the planning process can vary from several days to sometimes even several weeks. Capacity availability can be seen on the online catalogue, and the technical information and timetable information is represented as in the following example

The first table shows the path, timetable, and availability. Fees are also calculated using this sheet (not shown). The second table shows the technical requirements for different sections of the path, such as axle load, traction type, braking performance etc. This is a typical example of clear, open-access business-to-business communication (as opposed to business-to-customer communication that is so crucial for passenger train operators).

Figure 4: Example of international timetable (source: www.freightfreeways.com)

Rotterdam - Gioia T. (via Chiasso)		Path n.	Path Fee		Dist.	Running days and availability								not running / available / reserved / sold out
		41013			km	1	2	3	4	5	6	7	1	
			(1100 t)	(1600 t)										
Rotterdam														
	d	20.52												
Emmerich	a	23.12												
	d	23.52												
Gremberg	a	2.14												
	d	2.16												
Mainz-Bischofsheim	a	4.43												
	d	4.57												
Basel Bad BF	a	11.15												
	d	11.39												
Chiasso	a	17.01												
	d	18.25												
Milano	a	18.33												
	d	18.33												
Genova BR	a	21.22												
	d	21.30												
La Spezia	a	22.44												
	d	22.49												
Gioia Tauro	a	13.10												

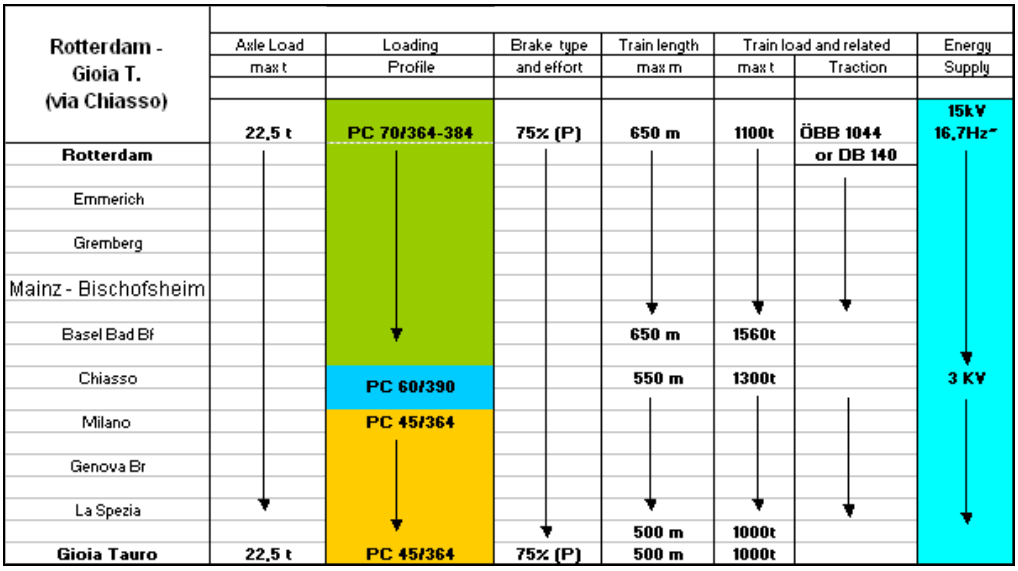
Prerequisites and/or limitations for the respective catalogue-path only
(if diverginh from limited infra-data of the line)

Brake type and effort		75% P
Train length max.	[m]	500
Train load calc.	[t]	1000
Traction		
Max. Speed	[km/h]	100
Other		

RailNetEurope shows how slot allocation procedures of several countries can be dealt with as one, and gives an idea of future possibilities for the European railway market. RailNetEurope goes beyond the access rights specified in Article 10 of EU Directive 91/440:

- It does not demand allocation between operators on equity basis, but simply gives capacity to any operator based in one of the participating countries.
- It also includes non-EU countries
- It does more than just slot allocation, it actually organises railway capacity for the operator at one desk.

Figure 5: Technical requirements for international path (source: www.freightfreeways.com)



5.4 Supply side – slot allocation and pricing procedures from the infrastructure manager's point of view

5.4.1 Implementation Drivers for the Infrastructure Managers

Capacity maximisation versus revenue maximisation

Different methods of charging for the use of infrastructure have been described in the previous chapters. A line can be drawn between schemes that maximise the IM's revenues when capacity is used to its limits, and schemes that opens up for contests that maximise operators' WTP at traffic levels below what can be obtained if the IMs set the timetable. In practice, maximum market share of railways (highest proportion of the travellers in a specific area travelling by train) may be reached by none of these methods, but as demand and congestion rises, the closer capacity maximisation comes to equal market share maximisation

Incentives for the IM to be cost efficient

Apart from the institutional context, the charging system itself can have some effect on the IM efficiency drive. Charging systems whereby the infrastructure charge is closely related to the actual cost level (e.g. a pure SRMC or full cost pricing regime) will leave little incentive for the IM to be cost efficient. But this is true only to the extent that such systems would require the benefits of any cost reductions to be passed on immediately to the operator. In reality, the level of infrastructure charge is fixed on the basis of budgeted cost and thereby any variance of actual costs below the budgeted amounts represents an additional profit.

If the IM does not have to set prices at an overall cost recovering level, clearly loosening the relationship between the actual cost level and the price charged, there will be an incentive to the IM to improve efficiency. Because the actual price levels are outside the scope of this study, our proposals do not include any direct guidelines for setting the level of margins, nor for varying them. However, in contrast with a fully cost orientated pricing system, our proposals allow the IM to deviate from only applying cost related pricing parameters, i.e. it can apply the market modulating parameter and negotiate with the operator a price that is different from the published tariff. In this way the IM can loosen the cost relationship.

Here we would like to point out that apart from the actual charging system it is important that contracts between the IM and the operator also sets sufficient incentives for the IM to be cost efficient. Contract clauses whereby prices are revised based on achieved efficiency improvements will clearly diminish any incentives for improvement. On the other hand contracts whereby charges are set for a period of several years, possibly based on expected efficiency improvements over this period, can give a clear incentive.

In this case, the agreed charges will not be affected by the actual level of cost reductions achieved by the IM for the length of the contract period. The IM will therefore have an incentive to reduce its costs and thereby to improve its return on investment.

Incentives for the IM to invest in new infrastructure

Investment incentives can be established by long-term contracts or investment engagements. These mechanisms can directly resolve capacity problems. By providing a balanced risk-sharing framework to invest, they ensure that all new infrastructure investment that can be paid back by profitable services is actually undertaken.

Also State intervention gives important incentives for the IM to invest in new infrastructure. Especially, investment and interest reimbursement can give important incentives for an IM to build new infrastructure.

Additional and ancillary charge

In addition to the charges described above, operators may have to pay for other services: traction energy (either electricity or diesel, if supplied by the infrastructure manager), access to the telecommunication network or the right to call at stations, which results in additional fees being charged by the infrastructure manager.

Attract more operators vs. more traffic

From a business point of view, an IM would like to bring more operators to rail in order to limit its risk of being dependent on one single large customer (i.e. the incumbent rail operator). Operators however, regardless of whether they are an incumbent or a new entrant, would like to see as little competition as possible in their market. They will emphasise the importance of increasing their traffic volume. In terms of pricing the IM will favour a low entry barrier for new entrants, e.g. a relatively low fixed charge. Operators already in operation will opt for reaping economies of scale by having a relatively high fixed charge and low variable charge.

Path allocation in timetable production and operation

Path allocation in timetable can be written as an optimisation problem: conflicting demand for track access with scarce and lumpy supply.

The path allocation in timetable must be based on the **operator's willingness-to-pay**. The utility of a service to an operator can be approximated by his willingness-to-pay. By imposing a tariff per slot, only operators with a willingness-to-pay higher than the tariff will request the slot. With the auction procedure, the operator with the highest willingness-to-pay can be selected. The operator accepts to pay a tariff that does not exceed his maximum willingness-to pay for a given slot.

Each combination of a route and time slot can be seen as a marketable good. There are substituabilities and complementarities in demand for these transportation goods. Operator's willingness-to-pay is connected with **the market segments** of the operator, which are linked to demand elasticity. **Demand elasticity** depends on:

- Type of traffic (freight, passenger)
- Type of good (perishable product or not for example)
- Trip destination (number of alternatives)
- Time of day (peak or off-peak period)
- Type of vehicle (high speed lines, slow lines)
- Trip length (short, medium or long distance e.g. national/regional)
- The demand for transportation is:
- Negatively related to the price of transportation
- Negatively related to travel time
- Higher if there are connecting trains
- Lower if there are other trains on the same routes in adjacent time slots
- Higher in some time slots than in others.

5.4.2 Expected Drawbacks in Implementing Charging and Capacity Allocation Policies

Not only are there difficulties in deriving and developing railway infrastructure charging policy, there are also barriers to the allocation procedures as well as in implementing policy once it has been agreed.

Problems may come in a number of different forms. Some may relate to the industry in general, irrespective of the member state or region involved, whereas others will be more country-specific, being linked to the institutions, finances or philosophy of that member state or region [Quinet, 2001]. Whilst industry-related problems are likely to apply more or less evenly across the different member states, country-specific problems may be very relevant for some member states but much less relevant for others.

In addition, problems may be perceived or actual. Perceived may exist where research is not effectively feeding through to the policy-making community. A failure to disseminate state-of-the-art research on issues affecting the implementation of marginal cost pricing may result in policy-makers perceiving there is a problem where there is not. It is important to expose these perceived problems through effective dialogue between the research and policy-making communities. In the end, the important task is to identify the actual problems and, subsequently, possible means of overcoming them.

The following list summarises possible problems/restrictions on slot allocation procedures, from the production side point of view, *always regarding the future situation*.

From the policy point of view, the relevant problems seem to be:

- Variation of railway reform across different member states – may affect international traffic
- Country-specific or organization-specific procedures may cause great difficulties in complete railway reform according to the EU Directives.
- Profit-maximising IMs creates a difficult environment for establishment of a system that serves the society in a way that is economically efficient

From the pricing point of view, the relevant problems are concentrated mostly on implementing marginal social cost pricing in the rail sector:

- Problems of measurement
- Complexity of tariffs
- Financial implications
- Equity
- Technical efficiency
- Fair competition within the rail sector
- Fair competition with other modes
- Acceptability on behalf of train operators and infrastructure managers
- Acceptability on behalf of end users and the general public.

From the allocation point of view, the possible relevant restrictions are:

- Existing poor quality of infrastructure may cause inability to satisfy operator requests
- Limitation of human mind in producing network statement, in single/few operators environment
- IM as the allocation body in some cases may cause unfair treatment among the different operator
- Limited information from the operator to IM may lead to unacceptable network description
- Processing of path requests may be time-consuming
- Open auction system may be time-consuming
- Secret auction system may cause problem to operator i.e. they cannot trade for the parameters set in slots

Last but not least, lack of suitable definition of property rights. The right to use a part of the network is not straightforward to define. Allocation of track is tied to the scheduling procedure. As this report has stated; the operators' valuation of a slot and ability to use a slot is a function of the whole scheduling process, where the final timetable sets the characteristics of each operators' property rights to possess the network,

5.5 A comparison between slot allocation procedures in railways and aviation

5.5.1 Lessons to Learn

The dynamics of the railways in the context of the implementation of the EC Directive 91/440 are evolving slowly, while is it more and more clear that the inefficient allocation of capacity in the railways is a major drawback to the development of the railway in the European context, in particular regarding the freight market. This aspect is currently deserving the focus of the European Commission, since to some extent, it is preventing the implementation of strategies envisaging the growth of the railway market shares, as extolled in the recent White Paper: 2010 Time to Decide. The new need for close cooperation between the demand side of the industry, represented by operators, and the supply side of the industry represented by the infrastructure managers, previously together in one single entity, is bringing along a certain level of conflict. Although such level of conflict has the potential to increase the overall performance of the system, it implies a new attitude from the stakeholders involved. It also obliges the adoption of improved management procedures on both sides in order to tackle efficiently the most common flaws inherent to contractual relationships involving rights and obligations for the parties.

While operators may adapt themselves to this new reality, moving from a production oriented strategy to a market orientated one, without really needing to sort out the basic constraints of the system itself, it is up to the infrastructure manager alone to decide on a wide range of crucial issues related to the infrastructure management such as long term strategic investments, optimisation of the capacity allocation or compliance with safety standards. These aspects are however critical and most of the times in conflict with the availability of the infrastructure.

This situation poses serious problems to the ability of the IM's to show increased performances, to some extent also because the vertical separation in Railways broke up the ties that could in theory allow to better manage the whole system (Supply + Demand). It is therefore crucial to define clear mechanisms to solve the conflicts arising between the operator (Railway Undertakers or Operators) and to specify in which conditions may the operator have access to the Infrastructure. This calls for clear procedures on the allocation of the existing capacity to the operator, which should be based on effective and clear market mechanisms, such as slot auctions. Such approach should enable the overall railway system to operate better and will allow keeping the pressure for optimisation, and ultimately better quality of service towards the end user, being it either passengers or freight operators.

In the last decades railway freight transport market share has decreased in comparison to other modes, because it is generally considered as slow, inefficient and unreliable. Prompt and flexible allocation of capacity, in particular at trans-national level, is understood to be one of the drivers for such situation.

In order to understand the theoretical aspects of slot allocation, we start by explaining how slot allocation is used in Air Transport, later linking such procedures to the management of capacity in railway infrastructures.

Slot allocation has shown to be an effective management tool in airports, maximising capacity usage and ensuring an optimal utilisation of the available resources. Therefore, congested railway infrastructure may be seen as a transport sector to which such procedures should apply. Since equity issues are a major concern, it is essential to define a fair, non-discriminatory set of regulations when it comes to dividing the available capacity. In air traffic, slot allocation has been used for decades; it provides the railway infrastructure managers with very valuable information and experience. The regulations used by the International Air Transport Association (IATA) are mentioned in this document.

In the context of IMPROVERAIL, it is interesting to see how the slot allocation process has developed, and which lessons are to be drawn from the skills and experience of the aviation industry. However, it must not be forgotten that some basic facts are different. Most importantly, a delayed plane imposes far fewer problems onto another plane, simply because one plane can easily overtake another. Furthermore, the aviation industry is much more volatile and competitive, offering a more level playing field for the involved

airlines. But still, the aviation industry offers a very interesting comparison. So, given that some conditions are different, what can be learnt from slot allocation procedures in aviation industry? The rules of procedure are explained below.

5.5.2 Slot Allocation in the Aviation industry

Insight on slot allocation procedures applied to air transport

The International Air Transport Association (IATA) rules slot allocation in air transport, co-ordinating flight schedules through its half-yearly Schedules Conference. Started by IATA in 1947 as a modest attempt to maximise interlining possibilities for a small number of airlines, the Schedules Conference (SC) is now additionally a world-wide forum for reaching consensus on schedule adjustments necessary to relieve airport congestion. With the help of airlines, airports, coordinators and industry experts, IATA has developed a set of procedures which are intended to provide guidance on managing the allocation of scarce resources at busy airports on a fair, transparent and non-discriminatory basis.

Procedures

When starting the planning and allocation process, IATA first makes a distinction between three airport categories:

- **Level 1** describes those airports whose capacities are adequate to meet the demands of users. Such airports are recognised from a schedule clearance viewpoint as non-coordinated.
- **Level 2** describes airports where the demand is approaching capacity and a more formal level of co-operation is required to avoid reaching, if at all possible, an over-capacity situation. These airports are referred to as schedules facilitated.
- **Level 3** describes those airports where demand exceeds capacity during the relevant period and it is impossible to resolve the problem through voluntary co-operation between airlines and where, after consultation with all the parties involved, there are no possibilities of resolving the serious problems in the short term. In this scenario, formal procedures need to be implemented at the airport to allocate available capacity and coordinate schedules. Airports with such high levels of congestion are referred to as “fully coordinated”.

For IMPROVERAIL, the focus will be on the third category, as it comprises the current requirements of the Railways in the context of a shortage of capacity to face freight modal shift from road to rail.

Fully Coordinated Airports (Level 3), must have a **coordinator** to allocate slots to all airlines operating from that airport. The coordinator should be appointed by the appropriate authority, following consultations with the airport managing body, the airlines using the airport regularly and their representative organisations.

The person appointed must act independently of any interested party. Previous airline scheduling knowledge and/or coordination experience is highly desirable. Coordinators must have sufficient time and resources to provide coordination services in accordance with these guidelines. If a country has more than one Level 3 airport, there may be benefits if one coordinator or coordination organisation deals with all such airports, e.g. the ability to invest for high quality coordination.

Ideally, there should be a dedicated coordinator. Where there is dual responsibility for coordination and scheduling, coordination must take precedence over scheduling. The activities of the coordinator must at all times be neutral, transparent and non-discriminatory.

When planning a slot schedule, the following general aspects are taken into account.

- Aircraft operations may be classified into the following broad categories:

  (a) Regular scheduled services

  (b) Ad-hoc services

  (c) Other operations.

- In the event of conflict arising between the interests of these different categories, priority should be given to (a) and then (b) above.
- The basic principle of the slot allocation process is historical precedence, which allows airlines to retain slots which have been allocated to them, and operated by them to certain operating criteria, in the next equivalent scheduling season. This principle is also called *grandfathering*.
- Historic slots must not be withdrawn from an airline as a means of providing for new entrants or any other category of aircraft operator. Confiscation of slots for any reason should be avoided, unless intentional abuse of the coordination system by an airline is proven.
- Slots may be transferred or exchanged within or between airlines subject to certain conditions.

In order to give airlines the necessary information on historical slots prior to the Schedules Conference (SC), coordinators should use the following guidelines for determining which slots are historical:

- Slots cleared by coordinators as ad-hoc are not eligible for historical precedence.
- Slots are eligible for historical precedence when four consecutive flights have been operated as allocated, at the same time on the same day of the week.
- Slots cleared by coordinators as ad-hoc but forming a series by the end of the scheduling season, **may** be eligible for historical precedence.
- Flights initially requested as a series of slots and cleared by the coordinator at different timings (ie. not forming a series of 4 consecutive flights at the same time on the same day of the week) but subsequently re-cleared before operation, so as to form a series by the end of the scheduling season, **may** be eligible for historical precedence.
- Slots held on file by coordinators at the slot return deadline dates of 31st August (Winter) and 31st January (Summer), will be used as the basis for determination of historics.
- For slots allocated by coordinators **after** the slot return deadlines, the number of slots in the series at the date they were allocated will be used as the baseline for the “use it or lose it” rule and the determination of historical precedence.
- Whether slots are requested before or after the slot return deadlines, it will be the latest timings approved by coordinators for each series of slots that will form the basis for historical slots.

Primary Criteria for Slot Allocation

The prime objective behind the allocation of specific slots should be to ensure the most efficient use of scarce airport resources in order to maximise the benefits to the greatest number of airport users and to the travelling public.

Against this background, coordinators should allocate the declared capacity based on the following priorities when developing an initial slot allocation plan for the Schedules Conference:

1. **Historical Precedence:** The core of the slot allocation process is the use of historical precedence. This precedence applies only to equivalent, and not consecutive, scheduling seasons (e.g. Summer to summer season) and is limited to the equivalent period and days of operation. This principle entitles an airline to claim a series of slots within the same coordination parameter(s) in the next equivalent scheduling season, provided that:

- The slots were allocated for regular scheduled services forming a series of slots;
- At least 80% of the slots were operated by an airline as cleared by the coordinator.

1 **Changes to Historic Slots:** A change to a historical slot should have priority over new demands for the same slot within the total capacity available.

2 **Slot Pool:** Once slots have been allocated at a fully coordinated airport as outlined above, the coordinator should set up a slot pool. Slots available in the pool should then be allocated to applicant airlines using the criteria set out below.

New Entrants

Within each time interval coordinated, 50% of the slots contained within the slot pool at the initial allocation must be allocated to new entrants, unless requests by new entrants are less than 50%. Other criteria for allocating slots from the pool are secondary to this criterion. An airline's request for a slot at an airport should have new entrant status provided that the request, if accepted, would not result in the airline holding more than 4 slots on that day at that airport. An airline must **not** claim new entrant status:

- if it intends to operate on an ad hoc basis, or
- if a controlling interest in the airline is held by another airline which itself is not a new entrant at the airport in question (subsidiary company), or
- if it holds a controlling interest in another airline which itself is not a new entrant at the airport in question (parent company).

A new entrant, who has been offered slots within two hours before or after the time requested, but has not accepted this offer, will not retain new entrant status for that scheduling season. Airlines must advise the coordinator if they are requesting slots as a new entrant. If new entrants are dissatisfied with the response to their slot requirements, they may request a meeting of the appropriate coordination committee to consider the situation.

Introduction of Year-Round Service

Within each category above, i.e. changes to historic slots, allocations to new entrants and allocations of remaining slots, a request to extend an existing operation to a year round operation should have priority over new slot requests. In order to assist coordinators to allocate the slots, airlines must advise the

coordinator that they are requesting them for year round operation. Coordinators should allow flexibility on timings to cover the differing requirements of short and long-haul services.

Additional Criteria for Slot Allocation

When slots cannot be allocated by the application of the primary criteria as set out above, further consideration should be given to the following factors:

- **Effective Period of Operation:** When two or more airlines compete for the same slots, the schedule that will be effective for a longer period of operation in the same scheduling season should have priority.
- **Size and Type of Market:** There is a requirement for a mixture of operations at major airports to satisfy the demands of the public. Domestic/regional/long-haul markets, covering both scheduled and charter services, are part of a total pattern and the size and type of markets and the airport network and links should, therefore, be considered.
- **Competition:** Coordinators should try to ensure that due account is taken of the competitive requirements in the allocation of available slots.
- **Curfews:** When a curfew at one airport creates a slot problem elsewhere, priority should be given to the airline whose schedule is constrained by the curfew. In order to assist the coordinator, the airline should indicate that it is constrained by a curfew.
- **Requirements of the Travelling Public and Other Users:** Coordinators should try to ensure that the needs of the travelling public are met as far as possible.
- **Frequency of Operation:** Higher frequency should not in itself imply higher priority. The situation of charter and freight airlines should be particularly considered in this context.
- **Local Guidelines:** The proliferation of local guidelines is to be discouraged. However, conditions vary from airport to airport and therefore, when establishing priorities, the coordinator should take into account necessary local guidelines. Such guidelines must be approved by the local Coordination Committee or its equivalent.

Transfer of Slots between Airlines

Slot transfers between airlines may only take place where the laws of the relevant country permit. Slots may only be transferred to another airline that is serving or planning to serve the same airport. The transfer of new slots is not permitted until such slots have been operated for two equivalent seasons. This is to prevent airlines taking advantage of an enhanced priority, such as new entrant status, simply to transfer them to another airline.

Recent Developments on Slot Allocation

On 12 July 2001 the Council decided to consult the Economic and Social Committee (ESC), under Article 80 (2) of the Treaty establishing the European Community, on the:

Proposal for a Regulation of the European Parliament and of the Council amending Council Regulation (EEC) No. 95/93 of 18 January 1993 on common rules for the allocation of slots at Community airports

COM(2001) 335 final - 2001/0140 (COD).

This initiative aimed to re-focus on the management of slots, and - in conjunction with that - to reflect ATC, airports operation and capacity issues alongside current environmental objectives, to impart fair and transparent procedures to protect and encourage the industry and users alike and arbitrate upon congestion. It seeks to offer clarification of the definition of slot rights, airport status, new entrant management and coordination. It also has the objective of finding and maintaining the right balance between air carriers and the development of a competitive network within the EU and with third countries.

The Section for Transport, Energy, Infrastructure and the Information Society, which was responsible for preparing the Committee's work on the subject, presented its conclusions on 26 February 2002. At its 389th plenary session of 20 and 21 March 2002 the Committee adopted the following proposal unanimously.

About Principles of Slot Allocation

- Slots are considered as "rights to use infrastructure" and not "property rights". This does raise the question of the proposed examination of slot trading and the inevitable challenge by flagship carriers that the "grandfather right" embodied in the proposal is de facto their "property".
- There is concern at the provision (Article 2 (b)) to bar partners in route sharing from new entrant status; such route sharing has sound reasons e.g. load factor, environmental impact, services, to justify it.
- The comfort of "grandfather" rights gives balance to the process of slot mobility, recognition of historical commercial costs and control of transfers.

About Coordination

The time-window for which slot allocation plans are made can vary. Some references suggest six-monthly periods, summer and winter, elsewhere the emphasis is on year round operational provision. It is important that these periods be defined in order to offer the widest opportunity for competition to re-position slots. Six-monthly periods would appear to be the most responsive format.

The appointment of the coordinator must be totally independent and apolitical. There is concern that the coordination exercise could become both costly and bureaucratic. The Committee emphasised that:

- Coordination is established as a totally independent entity;
- Member States adequately ensure their operational budgets and assure their authority;
- Management systems be developed in cooperation with airports to create the data that ensures a fast creation of solutions.

About the Role of the Coordinator

The neutrality and independence of the coordinator are the essential ingredient for the success of the proposal. Member States must provide indemnification to coordinators so that they may act in an unimpaired manner to pursue their brief and respect their principles. This does not remove any responsibility from the Coordinator to satisfactorily account for its actions and decisions.

It is assumed that standardised data will be made available to the industry at large, within defined response times, to ensure best competitive knowledge is disseminated. The ESC insists that coordinators cooperate with relevant authorities and respect the provisions of Article 81 and 82 of the EU Treaty to ensure that resulting decisions are favourable for all air-traffic users.

About Slots allocation and entitlement

Refinements to the process are justified. There is concern that coordinators are not compelled to arbitrate upon "alternative" transfer modes, which is outside their field of responsibility. Intermediate capacity review should only happen after significant changes occur to airport capacity, or at three years' intervals.

About Enforcement

It seems reasonable that non-performance is penalised by both fines and slot withdrawal. The coordinator must nevertheless act expeditiously to limit collateral damage to airports from such actions. Given the recent asymmetric shocks to the air-traffic industry, coordinators should hold a degree of autonomy to deal wisely in such occurrences.

Final Remarks

- Well-displayed user-friendly records by way of e.g. score boards showing performance achievements, would be of interest. Slots' usage and punctuality performance must be reported to show actual and trend reliability.
- There is much emphasis on new entrants developing new routes. All carriers should be so encouraged, those already established then also having more leverage. Recognition of effective competition should be the driving principle.
- The allocation of slots will require sensitivity in the policing of "use it or lose it". Coordinators must not be bureaucratic and restrained by red tape, but should retain some authority to exercise discretion e.g. when a carrier is dislodged from a slot by the direct interventions of serious disruptive actions by terrorists. If airlines can account for their under-performance to the coordinator's satisfaction, they should be accorded the right to retain their slots for the subsequent coordinated period, to facilitate recovery.
- Whilst the impact of forthcoming reports is awaited, it is the ESC's view that coordinators reflect the latest understanding of environmental constraints in their selection process. It is anticipated that such findings will clarify the weighting of their impact upon decisions.

5.5.3 Lesson learnt on slot allocation procedures from the air transport sector?

How do slot allocation procedures relate to railway infrastructure management? What lessons can be drawn from current and best practice in airport slot management? To assess this, let's have a look at the procedures and criteria.

Procedures:

IATA distinguishes three categories of airports, according to the way they cope with demand. They are coordinated or non-coordinated airports, meaning that the former do need a particular level of slot allocation, whereas the latter do not, since they a relative abundance of capacity. This principle can be applied to railway stations and junctions as well, distinguishing between congested nodes and quiet countryside lines. Crucial point however, is that the IATA procedures limit themselves to the nodes, leaving the airspace in between untouched. Obviously, this airspace is heavily regulated in congested areas such as Europe and the US. On the other hand, "empty" areas such as the Pacific and the Poles, are virtually unguarded, and capacity allocation is hardly an issue there.

Projecting this situation on railway infrastructure, it would imply that slot allocation can be limited to those places where demand for infrastructure capacity exceeds supply. Indeed, it would seem strange to have bids and auction for access to stretches of railway with only one single operator. The problem starts, however, when a new entrant wants to have capacity and there is a clash of interests. In this case, the major difference between tracks and airspace manifests itself: railways are physically very inflexible, compared to airspace where every route has several "flight levels", vertically separated flight paths where planes can overtake each other. That is why, for the sake of clarity, it is probably more easy and fair to have one standard system for the entire railway network.

IATA wants to have an independent dedicated coordinator. When railway IM's are completely independent from the operator, which they already are in some countries, this is the case in the railway world as well.

The IATA rules stipulate that half of the slots are given to airlines that already held slots in the previous equivalent (summer / winter) season (the *grandfathering* principle). In order to be eligible for such a claim, an airline must have used at least 80% of the allocated slots in the relevant period. Concerning railways, it seems that such a regulation can be implemented easily, giving new entrants a fair chance to establish themselves; and at the same time, it gives an incentive to incumbent operators to have trains running more often in order to preserve their slots. This could improve the service of public transport of which in the end the customer would take the benefits. However, this regulation could perhaps be applied to less than 50% of the slots, since it would presume a market volatility that the railway sector probably does not possess.

IATA classifies aircraft operations into three different categories: Regular, Ad-hoc and other, in descending order of priority. Furthermore, ad-hoc operations are not eligible for *grandfathering* claims. Railned, the Dutch rail operations regulator, classifies the train operations in a similar way. Hourly-pattern operations have a higher priority than the daily ones, which in turn have a higher priority than the occasional ones. Obviously, there is a dilemma when dividing slots: in order to maximise usage of the infrastructure, the infrastructure manager will want to give out as much capacity as possible, within maintenance constraints. This does eliminate flexibility to meet with sudden changes in demand, however.

The "use it or lose it" rule applies only to those slots that were allocated before the IATA deadline when determining historical precedence. This rule can obviously be applied easily and justifiably on railway slot allocation.

New entrants

IATA states that 50% of available slots must be allocated to entrants, unless the requests amount to less than 50% (in which case all requests of newcomers will be granted). However, this cannot result in the newcomer having more than four slots a day at that airport. Newcomer status is denied if the airline has a controlling interest in another airline that already obtained slots at that airport, or if an incumbent airline has a controlling interest in the "newcomer". All these regulations can be easily transformed into railway regulations, if so desired.

Newcomers can be less choosy when it comes to exact timing of slots: times can vary up to two hours from the original request. Furthermore, requests for extending existing operations receive priority over requests for new slots. All of this will fit the railways very well, since it matches the current situation practised by railway regulators.

Additional criteria for slot allocation

In case no agreements are made, IATA has the following additional criteria:

- Schedules that cover a longer period of operation will receive priority. Completely implementable by railways.

- Size and type of market: domestic/regional/long-haul market must be served in a healthy and appealing mix. Well implementable by railways.
- Competition: slots are allocated in a way that will boost competition. Can be implemented in railways.
- Curfews: when a curfew at an airport creates a problem elsewhere, the affected airline will receive priority. Might be less of an issue at railways, since train services can be shortened more easily at late hours than flights.
- Requirements of the travelling public and other users: the equivalent of the PSO, in practice giving passenger trains an advantage over freight trains.
- Frequency of operation: higher frequency does not imply higher priority in aviation. However, for trains this might be a different story, considering the Public Service Obligation.
- Local Guidelines: to be discouraged according to IATA, and not relevant in national railways, with the exception of shunting licences: there are cases known where a municipality withdrew the licence for freight operators to shunt in the city centre. This is not normal practice, though.

Integral slot allocation: "Acoustic Timetable"

In The Netherlands, currently there is a so-called "Acoustic Timetable", a computer program that uses the train timetable and rolling stock characteristics as input to calculate the total noise "pollution" that rail traffic generates. Rolling stock, and especially engines, are already classified using four categories, similar to the ICAO noise chapters in aviation. Currently, there is a new version under development, anticipating a new law that will put an upper limit on noise pollution by trains. As soon as the new law is implemented, noise pollution will become a crucial element in slot allocation, especially concerning freight trains, since they are generally noisier. If an operator cannot operate more freight trains because of reaching the noise limit, there will be a strong incentive to invest in new, more silent rolling stock.

This Acoustic Timetable was implemented earlier by Amsterdam Schiphol Airport, and has led to major changes in slot requests, so that at some point the Dutch Traffic Minister even threatened to close runways if the violations of the noise constraints continued. Currently, a new system is implemented where noise is actually measured by microphones instead of being calculated as a function of flight paths. The old system did not distinguish between overflying residential areas and industrial areas, whereas the new system measures noise mainly in sensitive, densely populated areas.

5.5.4 Managing the relationship between IM and RU in the scope of Slot Allocation

With regard to the legitimate expectations from the railway demand side (Railway Undertakers), the following aspects should deserve special attention in the application of slot allocation:

- The preferred duration of the contracts between infrastructure managers and train operating companies differs considerably between parties. In order to make an investment in rolling stock worthwhile for a train operator, the operator will want to have a long contract in order to guarantee stability of fees; the infrastructure manager on the other hand will want to maximise flexibility by having contracts as short as possible. *Grandfathering* partly solves this problem, but will also act as a barrier against new operators entering the market.
- Slot allocation presumes a free market with competing parties. In the case of railways, the market might simply not be big enough for genuine competition, as in the case of scarcely populated countries. To reach the full economic and operational potential of slot allocation in these cases might be hard, if not impossible. This is similar to uncoordinated airports

- Some IM's still have very cosy relationships with the national railway operators. This does not benefit the entrants, and will hamper the full development of competition. Non-discriminatory treatment for different operators is absolutely essential.
- An integrated international market for slot, freight or passenger, would certainly remove barriers for railway transport and make it a more competitive transport mode.
- Penalty systems could be applied, but determining how much damage is caused by a delay is very difficult; the time of the delay is a factor but also the number of trains affected by the delay. Finally it is not always clear who is responsible for delays. However practical systems can be developped, accepted by both parties and put into practice, as the example of the private concession of Fertagus in Portugal clearly shows.
- A well-functioning and flexible system must be offered to the various operators, rules that are imposed should be considered fair, operators must perceive to be using a good product. New systems are only accepted if they work well.
- Flexibility from the IM side in allocating alternative paths, allowing operators to meet sudden changes in demand; and flexibility with re-routing in case of sudden obstructions or other unexpected problems.
- Clear and up-to-date information from the IM side, providing the operators with transparent conditions, options and possibilities through high-quality Business-to-Business (B2B) information systems.

The following table summarises what may be understood as major flaws and strengths looking at the above mentioned procedures:

Table 6: Strengths and weaknesses of slot allocation

STRENGTHS	WEAKNESSES
• Best utilisation of available infrastructure	• Vulnerability to delays
• Good representation of true demand for capacity	• Inflexibility
• Effective management tool	• Mismatches at national borders
• Procedural transparency	• Uncertainty among operators concerning investments
	• Responsibilities in case of delays not obvious
	• Potential unfairness towards newcomers

6 Charging procedures – potentials and pitfalls

6.1 Complex issues regarding charging procedures

6.1.1 Peak vs. off-peak prices

Because of congestion and under the road sector background, the slot allocation in railways requires the introduction of peak/ off peak pricing system. In road sector, to make each traveller face the marginal social cost of her trip, it is necessary to levy a charge equal to the difference between that marginal cost and the portion of average variable cost that is already borne by the traveller. The marginal value of time depends on the total time for the trip. To evaluate the value of time, we can use market segmentation (the sample is divided into segments according to willingness to pay, to the demand elasticity). Another solution is to postulate a functional form for utility that determines how the marginal value of time varies.

If an operator's time value is close to the average, he will incur the "toll payment" that everyone is faced with. If an operator's time value is higher (lower) than average, he would be willing to pay more (less) than the average "toll payment" for taking a slot. During the peak period, the demand for trips exceeds capacity. With a fixed capacity, the infrastructure manager can propose a higher tariff during the peak period in comparison with a lower tariff in off period. In accordance with his willingness to pay, the operator will make her choice in terms of slot buying. As long as there are buyers for all the previously specified trains (slots),the revenue of the infrastructure manager is maximised.

6.1.2 Handling of quality diversification

Diversification produces different kinds of trains and traffic on the same track or on the same network. We will address in this part of the report how various kinds of traffic and various kinds of trains might or should be handled by the slot allocation process together with the pricing scheme.

First, we have to define to what extent the diversification of traffic and trains might lead to some economics problems. Then we will try to analyse what might be the possible solutions.

This will be done for:

- Infrastructure costs;
- Scarcity costs;
- The nature of the passengers or goods on the train.

The infrastructure costs

The first question is related to the different characteristics of trains, as they are the causes of different costs. Trains might vary according to their physical characteristics: axle weight, average speed, length and so forth. Each of those characteristics possibly leads to some additional costs. Weight causes some additional maintenance and renewal costs. Higher speed also causes some additional costs. Maximum curvature of track for example is linked to the maximum speed allowed on this track. Obviously, some costs are also directly linked to the length of the trains.

Concerning those characteristics of trains, the principle should be that each train should be allocated to a group of trains, according to the cost of operating every kind of train. Ideally, if we suppose that the principle of marginal cost is applied, each category of train should bear the additional costs it is causing.

In certain networks, this pricing mechanism might lead to specialize some part of the network, with different geometric characteristics. On some very busy routes, it makes sense to have two lines: one for slow trains (freight and commuter passengers) and one for fast trains (long distance passengers). The opportunity for such an investment might be not seen if the charging system does not identify and allocate the costs.

The scarcity costs

There seems to be some confusion about the concept of scarcity costs. In this report scarcity costs are defined as the alternative value of slot. Normally, this concept only comes up in a process of altering a fixed timetable. For free capacity the scarcity cost is the cost of using the slot instead of letting it be left unused (as no other operator has demanded it). This cost will then normally consist of increased congestion costs/ delay costs.

Where the demand for slots is greater than the supply, handling the diversity of the trains lead to take into consideration the speed, because the slot attributed to the train is bigger for a slow train. Theoretically, the price to be charged to the slow train is the opportunity cost of the slot or fraction of slots consumed. This means that it is necessary to have an idea of this cost. Without a kind of market mechanism for the slot allocation process, it is very difficult to have an idea of the willingness to pay for the slot attributed. One possibility might be to compensate the operator whose train is delayed or cancelled, with an economic calculation of the costs of delays and cancellation. But one should keep in mind that those economic calculations are not very accurate and are relying on rather rough assumptions. To a certain extent such a compensation mechanism could provide an incentive to allocate "efficiently" the slots: the low-value trains having a tendency to run on a period of time where the opportunity cost of the slots is lower.

The diversity of traffic

a) The welfare implication of delays or cancellations of trains

In case of delays or cancellation, because of the slot allocation process, or because of delays imposed on another train, the consequences, in terms of welfare for the society, might greatly differ.

One of the first reasons is that different alternate modes of transport might be relevant and more or less easily used. A compensation mechanism to the end user of the train, and channelled through the operator might provide both an incentive and a fair solution to the crowding out effect.

But the private cost of a train delayed or cancelled is different of the cost born by the society, notably because of externalities. A kind of penalty might be charged upon the operator (and finally the end user) and thus provide a kind of internalisation of the externalities. Of particular concern are, depending of the countries, the environmental externalities (local and global) and the accidents, with a value of life to be decided by the political authorities.

b) The contribution to the objectives of the charging system

It is desirable to have consistency between:

- The infrastructure charging system,
- The slot allocation process;
- The handling of quality diversification

It follows that some of the objectives of the infrastructure charging system may constrain the handling of different quality of traffic. Notably, if we suppose that one of the aims of the charging system is to recover the costs of investment, it makes sense to charge the traffic according to the willingness to pay. In other terms, price discrimination can be introduced in order to finance some investment.

As a conclusive remark, we stress the fact that various factors might lead to differentiate access charges for different kinds of trains or traffic. The general objective should be to recover some sorts of costs, including external costs. The most controversial practice (at least in relation to current practice) could be to discriminate the access to the infrastructure according to the willingness to pay in order to maximize the return on investment.

6.1.3 Handling of delays and risk of delays

Background and principles

The main principle we propose for delays is to compensate the different entities involved in the delays. That means that it is necessary to calculate the costs for the different parties. The regular courts might do this, but some basic computations are possible and a special arbitration body might intervene in case of disputes or of more complex circumstances than those assumed in the basic computations..

We are only dealing with the delays caused by the infrastructure manager without any doubt. If the different parties do not agree on the responsibilities for the delays, an arbitration or judiciary body, with the expertise capability, should pronounce judgement. Alternatively, when there are doubts on the responsibilities but no big damages have occurred, a 50/50 split may be used with lower costs of the allocation error than would have been the costs of the arbitration process. This is the practice in the contract of Fertagus, the private concessionaire of a suburban link in Portugal.

It is necessary to distinguish between:

- A delay that was foreseen at the signature of the contract between the operator and the infrastructure manager and thus included, with a compensation mechanism, in this contract. A quality of service clause in the contract should make sure that the delays covered by the contract do not exceed a certain level. The economic theory of contract is relevant to analyse those kind of contract, but this is somewhat out of the scope of this report.
- A delay exceeding the contractual level and thus requiring a special appraisal of the damaged inflicted to the operators and the final clients. In this case, two situations are to be distinguished:
    - The delay is anticipated and the users can take any appropriate measure to mitigate the effect of the delay;
    - The delay is occurring without notice and thus the user of the infrastructure have to bear the full consequences of the delay.

We will now address the question of the appraisal of the costs of the delays (detour included). The cost of a delay is to be valued with reference to a regular timetable, "contractual" delays included. The delays are to be assessed for all the trains delayed, and thus an important delay leads to numerous trains being delayed and to an important compensation.

Assessment of the costs of delays

In the cost of a delay, the following parties are to be taken into account:

- the state
- the client (the operator)
- the final clients
- passengers
- shippers

In case of frequent unanticipated delay we suggest to consider the cost of a permanent delay.

The main problem is an occasional unanticipated delay, which might be the cause of tremendous costs for the operators and the shippers. Great Britain is an interesting market where some experience has been gained. See examples in section 7.4. Anyway, more research is needed.

1. The costs of delays might be calculated by an arbitration body; having the required expertise
2. This calculation is likely to lead to high cost estimates. This is the reason why some contracts should be established in order to foresee the compensation in case of possible delays
3. The most important case is the unanticipated and occasional delay that can disrupt totally an industrial process; given the possible costs and the corresponding compensation, an independent IM obviously needs insurance.
4. The calculation of the costs of the delays could help the infrastructure manager to manage the risks of delays, delaying more the trains with low costs of delay.

6.1.4 Handling of additional trains to scheduled trains asking for slot

Handling of additional trains asking for a slot is especially linked with delays and risk of delays analysis, peak-off peak pricing system, quality diversification. In other words, the integration of additional trains depends on the demand for trains already accepted.

Handling of additional trains consists of in the evaluation of the “opportunity cost”, per unit of slot sold, for an additional demand for a slot. This new demand is a marginal and variable one, which may be calculated for each slot.

For maximising profit, the infrastructure manager or the regulator body should minimize this opportunity cost.

This additional demand evaluation depends on different constraints, as the following:

- Capacity constraints: technical conditions (capacity in number of trains, type of line, type of train, maintenance operations), level of congestion on this slot.
- Security constraints: maximal speed, signalling etc
- Quantity and quality of the demand already accepted: additional demand is links with the demand already fixed. So this new demand does not modify the quality (in terms of speed for example) or the quantity (in terms of the capacity in the number of trains) of the previous demand. Precisely, the risk of supplementary delays because of this new demand must be equal to zero. This additional demand can be based on a “forecast probability distribution”.

The evaluation of the opportunity cost underlines the capacity of the infrastructure manager or the body regulator both to allow, to react and to anticipate the additional demand. In this way, it seems to be necessary to preserve a flexible percentage or part of the contract for this additional allocation demand (or for new negotiation).

6.2 Timetabling and slot allocation: Examples from Germany and UK

This section provides an insight into track allocation procedures that are performed up to now. It is focused on the problem, how slot requests are brought into an order in the timetabling process and what happens, if the conflict cannot be solved.

The timetabling process is described for two developed markets – UK and Germany. Whereas the Infrastructure Manager in the UK is completely independent from TOC´s, the German IM is part of the DB Holding, which also keeps the TOCs of DB under the same umbrella. In the recent months, the slot allocation rules set up by DB provoked a conflict that finally had to be solved by a decision of the Railway authority. The decision revealed the discriminating potentials of the procedures performed up to now.

Pricing the railway infrastructure becomes more complex when there are certain routes and/or certain times for which some path requests of different train operators exclude each other. Then a mechanism has to be found, that decides which operator gets the right to use the infrastructure as requested.

This path conflict always existed. In the former state monopolies it was solved internally. In most state railways there should have been a hierarchical timetable production, with the paths for fast long-distance passenger trains being implemented firstly, followed by the regional and local passenger trains. Freight traffic would then be assigned the leaving capacity with slow paths that often are interrupted by other traffic.

This allocation rule is no longer sufficient even from a purely administrative point of view, when several train operators with different products seek to use the infrastructure. The European Directive 2001/14/EC on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure and safety certification [EP 2001/14] inspires the development of new allocation rules, but does not give any guidelines on specific allocation criteria.

Figure 6: Current path allocation process in Germany

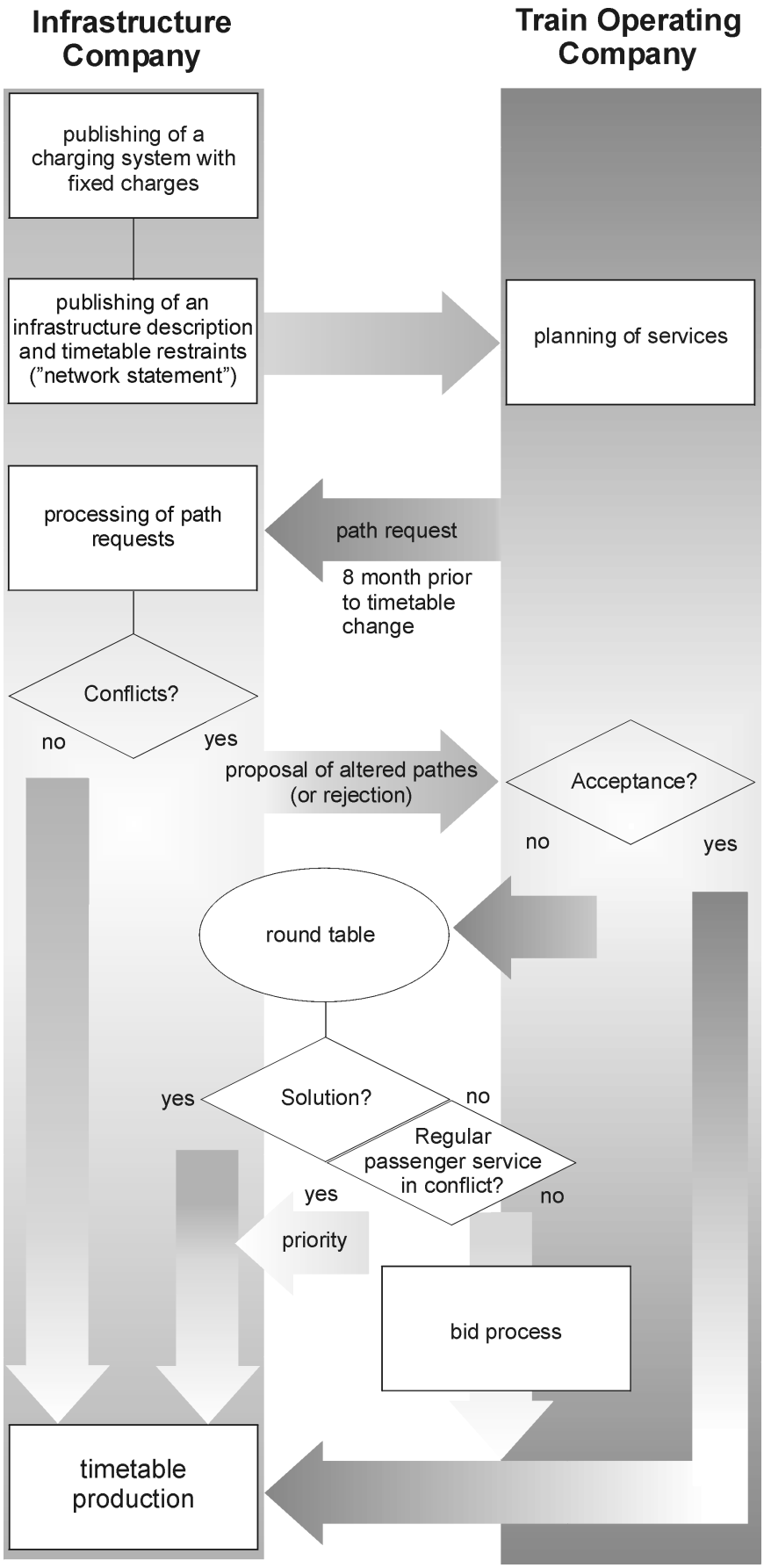


Figure 7 shows the current allocation process for Germany, which should be similar in many other European countries. The core of the process illustrated is the processing of the path requests by the infrastructure company (or by a capacity manager).

First the IM publishes a general infrastructure charging system and a "network statement" describing the state of infrastructure and external timetable restraints, e.g. from European timetabling. Based on this the TOC´s plan their services and form their slot requests to the IM, at the latest 8 months before the next change of timetable. The IM processes (sorts) the path requests by internal rules, partly given by public law. Without conflicts, the timetable can be produced. In case of conflicts, the IM can reject certain conflicting slot requests or propose altered routings. If the TOC accept the alternative routing(s), the timetable can be produced. If not, a round table of IM, TOC´s and the authority (Eisenbahnbundesamt) is organised as a kind of mediation process. If the round table comes to a common solution, the timetable can be produced. If not, the EBA has to decide if one service is to be classified as regular service whereas the conflicting service is an irregular one. In that case the regular service would have the priority. If none or both services are regular, the final allocation has to be decided within a bid process (cf. Section 8.4.2).

The box below shows two different frameworks that are used by Railtrack for Great Britain today, and by DB Netz for Germany (and in a similar way by ÖBB for Austria).

Figure 7: Allocation Criteria in Great Britain and Germany

Great Britain	Germany
"Public decision criteria" According to §4 Railway Act • Usage of the network in the most efficient and economical manner and in the interest of all users of railway services • Maintaining and improving the levels of service reliability • Maintaining and improving connections between railway passenger services • Evenly spread services where demand is evenly spread over time • Promoting competition • Avoiding frequent timetable changes Additional criteria: The duties of the TOCs through their franchise agreements have to be taken into account	"Administrative priority criteria" According to AEG (common railway law) • Non-discrimination • The needs of services with regular intervals have to be taken into account According to EIBV (regulation of the use of railway infrastructure) • Timely requests served before delayed requests • Paths bound by existing contracts before new requests • Requests consistent with the service description[1] before those which are not • Regular (repeating) services before irregular services • Long-run requests before short-run requests • Long paths before short paths

Germany

In autumn 2002, the German Nordwestbahn (NWB), a subsidiary of the French Connex Group and two public utility operators (Stadtwerke Osnabrück, Oldenburger Gesellschaft Verkehr und Wasser) requested slots for operations between Osnabrueck and Hannover and between Osnabrueck and Wilhelmshaven. The frequent service between Osnabrueck and Hannover should replace the former Interregio-traffic of DB, which was cancelled for financial reasons, from spring 2003 on. DB Reise&Touristik intended to substitute those Interregio-trains by Intercity-trains, where the ticket price is about 26% higher than on Interregio trains. Between Osnabrueck and Wilhelmshaven DB Cargo operates some irregular Cargo trains.

DB Netz refused access to the slots because of missing capacities. In December 2002 the new Anti-discrimination unit of the German Rail Regulator Eisenbahnbundesamt (EBA) decided that all slots have to be allocated to the NWB. For the cargo relation, the EBA stated a clear dominance of regular (repeating) passenger services before irregular cargo services, as it is also rules in the EIBV.

For the passenger relation the EBA gave the instruction to DB Netz to allocate the slots in a sealed-bid-auction within one week.

The EBA-decision was perceived as a pilot decision. On the one hand, the EBA refused a dominance of grandfathered slots as ruled in the EIBV. On the other hand, the EBA enforced the first bid process for slots in Germany. The management of NWB feared that DB Reise & Touristik could offer any price in that bid process because the auction revenues would directly flow back into the DB Holding. However, in the end DB has not delivered a bid, so that the slots were allocated to NWB.

The management of DB attacked the EBA decision verbally and legally at court. The EBA announced that it would file an appeal against any court decision different from its own decision. The court has not decided so far. According to the authority DB has done everything to delay the decision as much as possible.

6.3 International traffic: Harmonisation of charges

In Deliverable 1 of this project the current situation in Europe regarding charging was explored. A great variety of infrastructures charging systems are now in force in various European countries. The following section describes problems encountered caused by lack of harmonization of charges between countries.

The subsidization problem

For various reasons, the infrastructure charges might not cover the cost of providing an efficient quality and quantity of infrastructure. One reason might be that marginal cost principle is applied. The difference between the infrastructure charges levied and the cost has to be paid by any body in charge of financing this quasi-public good. Given the tax structure of the EU, it likely that the taxpayer of each country has to pay for his own infrastructure. There are some well-known problems in welfare redistribution effects of charging systems, subsidization and tax systems. One of them is the spill-over effect, where some non tax-payers, benefit form the public good because their location allow for that. But more specifically it is worth mentioning here:

- It is appropriate to have a link between the level of public good provided, the level of fees and the level of subsidies decided by an authority controlled by an elective power, where the taxpayers are also the voters and the beneficiaries of the public goods. It is an explicit choice to provide some special kind of quasi-public goods for some users. In the case of subsidization of rail infrastructure, the tax payer of a country with an efficient network and located in the centre of the EU could pay a lot for some trains just passing trough its network. This could lead to some wealth transfers which might not be desirable, nor anticipated and neither explicitly chosen.

- There is another side of this subsidization/transfer problem. A possible solution is to phase out global subsidization and introduce fine tuned compensation. But, to diminish the subsidies, a national government might be tempted to increase, beyond what corresponds to economic rationale, the fees for the foreign operators. This would create an allocation problem, and with risk for retaliatory reactions from other countries, this can lead to some inefficient situations analogous to the tariffs wars regarding international trade.

We will address now more specifically the question of allocation of resources.

The efficient allocation of resources

We can analyse the question from different perspectives. According to the strictest or strongest point of view, the same basic principles should apply everywhere, as there is a common market for goods and services. Transport costs and infrastructure charges are the prices to pay for a given service: there is no a priori reason that the price should be fixed with different methods in different countries, as any difference might lead to allocative inefficiency. Another way to look at the question of harmonization is to determine to which extent non-harmonization is costly, regarding the allocation of resources.

The first misallocation of resources involved in non-harmonization of charges is the allocation of track capacity.

As soon as there is scarcity of slots, and that some capacity investment might be needed, the question of the relevance of such investment is to be dealt with the consideration of alternate route, including the routes via different countries. It follows that difference in infrastructure charging system can lead to misallocation of investment in capacity, namely investing where it is not the most efficient.

Another misallocation of resources regards the running costs of the train. If the fee is lower in a longer route, this route can be used instead of a shorter one. There is here the possibility of a loss of surplus, because of more running costs (energy, wear and tire, wages, etc.)

The possibility of parallel competition

This kind of competition seems to concern, firstly, the freight transport and it will be more relevant as the EU expands eastward. If there are no harmonized charges, there is a possibility that the various infrastructure charges might preclude effective competition. It might be the case, for example, if a country has very high fees and that another one, for some various reasons, has very low charges. Even if parallel competition is not so important in a railways system with open access (Europe) as compared to a system without open access (The US), it might be both efficient by itself and helpful to promote a more competitive environment.

6.4 Service quality and product differentiation

The important thing for an optimisation of slot allocation procedure in railways is to allocate different slots with different quality of service. For example, the HGV line allows, in terms of travel time or comfort between point A and point B, a better quality of service than a regional line which is slower.

Thus, the slot allocation procedure must integrate train segmentation according to the product.

Firstly, we have to separate two type of “product”: passenger or freight. We can also differentiate urban/regional/national passenger train and perishable/non perishable product for example. Even if the differentiation can bring up some opposition, the product differentiation can be quite precise (see WP5) and connect with the demand elasticity.

In a second time, we can distinguish three attributes of service quality, which are equally connected:

- punctuality: when the punctuality of train decrease, then the quality of service decrease too. This characteristic needs an evaluation which integrates the methodology used for the delays and risk of delays calculation,
- speed: higher speed leads to the decrease of travel time, the quality of service is better. As the willingness to pay depends on value of time, the quality of service can be judged in reference of the train speed.
- comfort: the comfort (number of seating places, noise, frequency, information) is an element of the service quality, especially for passenger train.

6.5 Possible obstacles for creating an efficient railway market

6.5.1 Barriers to entry

Even if the market is open and we have established a marginal cost scheme, there can still be barriers to entry. If there is a barrier to enter the railway market, marginal cost slot pricing may be insufficient to create more competition in the train operating market.

A barrier to entry is an advantage enjoyed by firms already in the market that makes it difficult or impossible for other firms to enter. This is sometimes referred to as a relative barrier to entry. Legal and statutory monopoly rights will then make an absolute barrier to entry. What we discuss here is relative barriers to entry, since we are talking about relative disadvantages between competitors. We do not carry on this distinction in the further. A barrier to entry may be because of:

1. Legislation
2. Different cost structures
3. Capital market imperfections
4. Consumer loyalty

It is known that there are few legislative obstacles to enter the market of freight and person transport on the tracks. Then why are there not more new train operating companies eager to enter the market?

One answer is sunk costs. In competition with a company already in the market, an entrant will have a disadvantage. So, what are these sunk costs?

First, one common type of sunk costs is costs related to poor financing. Even after the separation between provision of track and operation of trains, the train operators faces high fixed costs. The initial investments necessary to enter the markets are substantial. If potential rivals have limited ability to obtain financing to purchase the necessary capital, entry becomes more difficult. Possible entrants may not be able to finance the appropriate scale of operations. This will make them less competitive. Even if the new company succeeds in raising enough capital, the interest rate might be higher, because of a high risk-premium. This increases the marginal costs of the new entrant.

Second, another sunk cost is the cost of advertising to get the new services known among the travellers.

The third, and possible the most important one, is the second-hand value of the capital. A company that plans to enter the market will have to do the calculation of what will be the assets if the company fails and goes bankrupt. If these investments could be recovered after a bankruptcy, this would only be a problem of financing the investments. But if the value of the capital that needs to be sold after a bankruptcy is much less than the initial value, a substantial amount of money will be lost during the time that the company is able to operate. This risk will have to be covered by a risk premium on the interest rate paid the creditors, and will be a disadvantage for the new company.

If the company already present and the possible rivals have the same cost structure of their variable costs of operating, the rivals will have a disadvantage because of their initial sunk costs, and a price war (predatory pricing) will probably push the rival out of the market. If the financing of the new competitor is limited as must be expected in a deregulated market (The only provider of virtually unlimited financing are the governments), there will be possible to push the new rival out of business without running much risk of going bankrupt for the established company.

If these structures are known in advance by the operating company in business, the rivals and the financing institutions, there is no surprise that new entrants to the train market are very few.

6.5.2 Modelling Financing an operator's investments to enter the railway market

We present here a model that illustrates the financing of an operator's entry to the railway market. Both the financing institution, hereafter called the bank, and the operator, called the borrower, who needs the funding are regarded as private profit-maximising firms.

The model is a two-period model. The first period has subscript zero. In this period the necessary investments to get into business are accomplished. In the second period, with subscript one, the operator is either running or has been declared bankrupt. The operator's revenue in period one is known in advance. The bank and the operator are risk-neutral. The set of variables is presented below:

Table 7: Set of variables for model for barriers of entry

Variable	Explanation	
π	Borrowers Profit	
X	Gross Revenue for the operator in period one when in business.	
p	Probability for the loans granted in period zero is paid back in period one. That is, the operator has not gone bankrupt.	
K	Necessary investments to enter the market as a train operator.	
A	The operators share capital	
L	The operators loan capital	K=A+L
R	Interest rate paid to the bank	
I	Interest rate	
ρ	The bank's rate of return	
b	Losses connected to bankruptcy	

The borrowers profit in period one is:

$$\pi = Xp + 0(1-p) - (1+r)L \text{ , if } \pi \geq 0$$

$\pi = 0$, otherwise

This gives us a critical value of p called $\hat{p}$ where π=0. $\hat{p}$ is given by:

$$\hat{p} = \frac{(1+r)L}{X}$$

The expected net profit for the operator can then be shown as:

$$E(\pi) = X\int_{\hat{p}}^{\infty} pf(p)dp - L(1+r)(1-F(\hat{p})) + 0 \cdot F(\hat{p})$$

The bank's expected gross profit E(φ), is shown below:

$$E(\varphi) = L(1+r)(1-F(\hat{p})) + X\int_{0}^{\hat{p}} pf(p)dp - b \cdot F(\hat{p})$$

The bank has two instruments to maximize their profit: L and r.

Differentiating the profit function by r gives us:

$$E(\varphi) = L(1-F(\hat{p})) - b \cdot f(\hat{p})\frac{\partial \hat{p}}{\partial r}$$

The first part of this expression is positive. This represents the increase in payments to the bank when the interest rate increases. The second part is negative and represents the higher risk of bankruptcy when the interest rate is increased. Setting this equation equal to zero, gives us the first order condition for optimum. The first order condition gives us an optimal r called r^*.

The rate of return for the bank's capital is given by:

$$\rho = \frac{E(\varphi)^*}{L}$$

Obviously, the bank has some minimum acceptable rate of return. We see that then both the interest rate and the maximum amount of loan are given. We call the maximum loan available for the operator L^M. If L^M is greater than K, the operator will be able to finance the necessary investments. If not, The operator will need additional financing, typically shares. The condition for entry to the market for the operator is

$$L^M + A \geq K$$

What cost elements are parts of K?

One major element is the purchase/ leasing of the rolling stock. Another element is all planning and investments that needs to be done in order to be able to plan a time-table for the routes. Here, the governmental demands for the financial and safety situation are of great importance. Another element is the money needed in order to stay solvent before the business starts paying off. In an industry of this scale we can conclude that this time period may be substantial.

In which ways can the government influence these decisions in a liberalized economy? In order to answer this question we need to find which variables that directly affect the financing of the operators investments. 'b,r,L,A,p,K,X,ρ.

'b' is a very central variable. We have seen how this variable directly affects the bank's decision. We will claim that this variable is a key variable to make the railways more efficient, and that it is already influenced, in a negative way, by national decisions.

Obviously, national rules and standards on infrastructure and rolling stock leads to a reduction of the second hand value of rolling stock. In fact, for some countries the only buyer of the rolling stock of a bankrupt company may be the competitor that drove the company out of business in the first place. This will obviously lead to a dysfunctional second hand market, (The original company will, through the bankruptcy of the rival, not only resume operation without competition, but also receive a reward in the form of heavily discounted material), and therefore destroy the possibility for competition. Thus, an adjustment of the national rules to a set of joint standards for the community and eventually also for adjacent countries, will improve the second hand market for rolling stock, and thus increase the possibility for competition on track. This is an example of a technological type of barriers to entry, not yet totally phased out.

All traffic on the tracks needs to be allocated in time and space. The Railway Infrastructure manager normally does this. If this process is slow and full of obstacles of different kinds, the cost for the company that needs to get a positive money flow may be dramatically high. Worse, if the national new railway sector has been ruled by a major company for many years, there might be personal bindings through earlier employment etc, leading to that the first company present has certain advantages.

L, A and K can be influenced by public funding or by adjustments of the financial claims by the authorities to grant access to the railways.

X can be influenced in multiple ways. By avoiding unhealthy competitive situations, that is to secure a certain level of ticket revenue and reducing uncertainty about this revenue, the provision of necessary capital will be easier. The government can also improve new entrants possibilities to succeed, by giving the operator lower variable costs e.g. by reducing the rail access fees, and further by providing some subsidies connected to the traffic. This can off course be done in multiple ways. PSO-contracts is one example.

So, how do these facts impact on the cost structure? Obviously, we are here talking about both changes upwards in the fixed investments costs and the marginal costs (e.g. the additional risk premium on the loans). Thus, a period of predatory pricing from the already present company is likely to succeed. Studying the case of a perfectly competitive market, where prices equals marginal costs, we can easily see that higher marginal costs for any entrant will make entry to the market impossible.

Comparison between a post-monopoly company versus a new entrant.

There is a common feature of the liberalised markets of transport and communication. Just a few years ago, in many European countries, telephony, railway and post were all provided by a single state owned company. All across Europe these monopolies have been opened up for competition. The old monopoly companies have had to learn to compete in a more liberalised market. The entrant lacks the knowledge, brands and markets of the former monopolist, but has the advantage of being able to optimally adjust number of- and qualifications of personnel and do the optimal investments taking a competitive situation into consideration. The last years have shown us that the original firms have done well in this situation, and that new competing firms have had problems to enter the market. Especially for railways this seems to be the case. This can lead us into suspicion that some characteristics of the railway market make the position of being well established in the markets an advantage.

Clearly, this is also the case in our model. Initially, the situation in many European countries was that a monopolist running on a deficit covered by the state operated the railways. Thus, for the investments made in that period the risk of the investments were zero, the railway operating company could not go bankrupt. In this period substantial investments have been done. Not only in infrastructure, but also in rolling stock, maintenance plants, amenities in connection to stations etc. This capital stock might be a great advantage for the original company, making it hard for newcomers to compete. The risk of bankruptcy for the settled company may still be close to zero. The total capital stock of the established company can function as A in our model, so that L – loan capital can be reduced. Therefore it will be easier for the established operator to make the necessary investments (that is invest to the capital level that maximizes profit per Euro) than for any newcomer. This will not be so if there are pending debts in the

former monopoly which are not fully underwritten by the State: in that case, additional borrowing by the established operator may be very difficult and expensive.

Are discounted slots a good idea?

If slot prices are designed to reflect the marginal costs (long term or short term) there is obviously no way that pricing under the marginal costs will lead to cost recovery in the market. This is enough to conclude that pricing under marginal costs will not lead to a stable situation where governmental transfers are not needed. Opening up for temporal pricing principles in the slot allocation, gives us some freedom to reduce the burden that we have seen fall on an entrant to the railway market.

Higher fixed costs can be compensated by

1. A lump sum transfer from the government to cover the entry costs of the new company
2. Tax reductions to increase overall profitability for the new company, or
3. Reduction in the marginal costs of production, that is reducing the price on the slots.

A version of (1) is public funding to provide sufficient supply of railway services at special times and special places that a pure profit-seeking company would not find profitable. Is it possible to provide this funding for special companies without tendering the contracts?

If the pricing principles of the slots are set equal to Long-term marginal costs, to make the slot revenue high enough to pay for renewal of tracks, a discount to one company automatically sets the price for the other competitors higher than LTMC. If the different companies run on different tracks, this can lead to some undesirable distributive effects for the passengers.

The capital cost concepts used so far have only covered the costs regarding the tear and wear of the infrastructure. If the difference in interest rate between the established and the newcomer can be included, a market with two or more relative equal companies might be possible.

The conclusion of this section is that a multi-operator environment is not a very likely situation for most railway lines. In order to increase the market share of the railways above what is experienced without public intervention, some financial advantages for the railway sector might have to be introduced. It is important to mark that these transfers should be incentive–neutral in all other extents than to favour the railways as a whole. The relative prices of slots, of infrastructure charges should be maintained in order to ensure efficient railway production. Through ownership, through public consumption of railway services etc. the public authorities are in position of favouring the railways.

6.5.3 Market imperfections

The slot allocation procedure will allow more efficiency (e.g. competitiveness) in the rail transport. However this new objective will face with some market imperfection still existing in this sector.

- One of the market imperfections is linked to the **market power of each national company,** which behave as they have some “grandfathers rights”. In fact, existing rail national operators possess natural monopoly characteristics such as economies of scale and have effective market power. The operator, who had the same slot in the previous timetable period, has priority rights to that slot in the next timetable period.
- On a European level, network access is only guaranteed for a limited number of categories, i.e. international rail services operated by international groupings of railway companies and international inter-modal transport which have market power too.

- Due to **safety requirements**, the capacity of railways is relatively limited and under constraints.
- Due to the **technical rail requirements**, time and space specific network access is determined in advance. For instance, certain users or user groups can be excluded from some infrastructure elements (high speed lines only used by high speed passenger trains), or transit demand bring up specific problems (connexion, transit in different countries European or not…).

As the European white paper (2001) said, there is a growing imbalance between modes of transport in the European Union. Most passenger and goods traffic goes by road. The flexibility of the car remains a "*symbol of personal freedom in modern society*" (White paper, 2001, p.23). Even if they are faced with congestion, road and air transports increase, while rail and short-sea shipping are yet impeded to become real alternatives to road. So the **intermodal competition** must be integrated in the slot allocation procedure.

6.5.4 Priority rules in solving path conflicts

During the slot allocation process, conflicting slot requests have to be solved by, for instance, negotiation, priority rules.

To resolve conflict, one request is to try to reach an agreement with both parties. For instance, the allocation body can propose to modify the requested train paths, for instance by assigning a (slightly) later or earlier train path.

In case of conflicting slot requests, different types of priority rules can be used to force a decision. For instance in France, the SNCF gives the priority of passenger trains over freight transport.

Priorities rules can distinguish: service types, vehicle type, vehicle occupation, line type, traffic type, existing alternative or not.

In practice, the infrastructure manager can specify a minimum or a maximum % (or random) of the capacity that can be assigned to each market segment. Directive 95/19/EC already had the possibility to adapt the tariff to the 'market situation'.

Another solution is to give the priority to operators (trains) with high value-of-access has the priority over those with low value.

In the Netherlands, the governments report (1999) suggests the following:

- priority for passenger transport during peak hours, with a guaranteed minimum
- capacity for freight transport;
- priority for freight transport in the evening/night, with a guaranteed minimum
- capacity for passenger transport.

It details three sub-segments (ordered by decreasing priority):

- international high-speed trains (on high-speed lines)
- other international trains, mainline trains
- regional trains

However, conflicting capacity requests may also arise within one market segment, for instance between two competing freight companies. In this situation, the Dutch allocation body (Railned) considers selling this slot in an auction procedure (see Koolstra, 1999).

6.6 Past, Present and Future of Track Allocation Rules

6.6.1 Current Practice

For the allocation of tracks today, mainly rules of thumb and political definitions are used to assess the "social value" of certain services. As a result, priority is given to

- Trains that are necessary for public service (F, NO),
- Trains that are part of regular / hourly service (NL, D),
- Trains that are operated by a TOC for which the infrastructure was built (F),
- International high speed trains over other forms of passenger transport (NL),
- Main transport over regional services at the main network (NL),
- Regional transport over main transport and charter traffic at the regional networks (NL),
- Grandfathered traffic prior to new traffic (D),
- Long-run request prior to short-run requests (D).

Only in some states and some cases slot conflicts are solved by auction processes, which are for example UK and Germany

Therefore systems in practise require definitions of network characteristics (high-speed network, main network, regional network), type of train services (main services, regional services, charter services), regularity of services and public service. Without precise definitions of those slot allocation criteria, slot conflicts cannot be solved in a reliable manner. Even if those definitions are given TOC´s may have incentives to manipulate their service in order to gain priority over competing services. In the end, current data used for solving the slot allocation problem may produce serious malfunctions. Only auction processes are free from that.

6.6.2 Needed Rules for Track Allocation

Auction Procedure

Under perfect information the IM could assess the willingness-to-pay of each TOC rather well and would set an infrastructure charge (or an infrastructure scarcity surcharge) that will be accepted only by the TOC with the highest WTP. The track access fee and the tariff regulations are for all the same and they are published. Then transparency is essential to this procedure.

With a fixed capacity, the infrastructure manager can propose a higher tariff during the peak period in comparison with a lower tariff in off peak period.

In case of delays or cancellations, because of the slot allocation process, or because of delays due to another train, a kind of penalty might be charged upon the operator. The cost of a delay is to be valued with reference to a regular timetable, "contractual" delays included. The delays are to be assessed for all the trains delayed, and thus the delay of one train might lead to numerous trains delayed and a considerable compensation. If the different parties do not agree on the responsibilities for the delays, an arbitration or judiciary body, with the expertise capability, should pronounce judgement.

The main problem is an occasional unanticipated delay, which might be the cause of tremendous costs for the operators and the shippers. A special study would be needed. One solution is to set some limit for

what is referred to as an incident, which should be compensated, and what are major events, where compensating all parties seems unreasonable.

The costs of delays might be subject to a standard computation rule for the typical cases, and calculated by an arbitration body, with the necessary expertise, when special cases come up.

Market target

The slot allocation procedure should differentiate slots according to:

1. Passenger/ freight
2. Urban/ regional/ national passenger trains

This slot allocation procedure is linked to service quality, which are connected to:

1. Punctuality: methodology for the delays and risk of delays calculation is useful
2. Speed
3. Comfort

One market imperfection is linked to the market power of each national company, which behave as they have gained certain "grandfathers rights". The operator, who had the same slot in the previous timetable period, has priority rights to that slot in the next timetable period.

An adjustment of the national rules to a set of joint technical standards for the community and eventually also for adjacent countries, will improve the second-hand market for rolling stock, and thus increase the possibility for competition on track.

In order to increase the market share of the railways above what is experienced without public intervention, some financial advantages for the railway sector might be introduced. It is important to mark that these transfers should be incentive–neutral in all other extents than to favour the railways as a whole.

The implications of infrastructure charging systems and slot allocation mechanisms are not independent from each other. As Ewers et al. (2001) showed for the slot allocation problem in the airline industry, IM may either use charges to cash out an excess of demand over supply (ex ante) or use auction mechanisms to allocate the free capacity to the user with the highest willingness-to-pay (ex post).

Under the conditions of perfect information, perfect competition and independence of IMs and TOC´s both solutions lead to the same results:

1. Under perfect information the IM could assess the willingness-to-pay of each TOC perfectly and would set an infrastructure charge (or an infrastructure scarcity surcharge) that will be accepted only by the TOC with the highest WTP.

2. Under perfect information and perfect competition among IMs the (surcharge) will be set up to a level just crowding out the demand of the TOC with the second highest WTP. This will ensure that the TOC with the highest WTP will carry the opportunity costs of the final allocation result.

3. Under perfect organisational separation of IM and TOC the setting of infrastructure charges is free from discrimination against certain TOC´s.

In the real world, those conditions are not fulfilled. A perfect separation of IM from TOC´s will be achieved by the complete implementation of EU Directive 2001/14. In the meantime some infrastructure charging systems may contain some elements of discrimination. Moreover, competition among IMs will remain imperfect due to public subsidies and to the geographic extension of some networks. Scarcity oriented

charging therefore may lead to a “monopolistic crowding out” of some traffic. This recommends a certain caution with infrastructure charging systems from the regulatory view: IMs might have an incentive to set scarcity (sur-) charges in an exaggerated manner. As a result, of course, slot conflicts will not arise, but the overall level of railway traffic is socially not optimal. Regulators will have to prevent such developments.

However, the main problem of IMs is imperfect information about the valuation of traffics. Only slot auctions are suitable to reveal the real WTP of certain conflicting traffics. However, some elements of infrastructure charging systems as performed up to now contribute to the avoidance of slot conflicts ex ante: An infrastructure charge containing a relative speed component contributes to a saving of capacities. Moreover it dissipates slot conflicts due to different speed requests. However, it cannot solve fundamental slot conflicts.

Infrastructure charging systems which take into account the general traffic density or which contain a peak-load component set incentives to TOCs to reschedule traffic with lower WTP to the off-peak. This results in a reduction of potential slot conflicts. Moreover they lead to a self-selection of TOCs according to their WTP for certain services.

All in all, slot coordination by infrastructure charging evokes a crucial conflict: On the one hand, low infrastructure charges do not provoke a monopolistic crowding out of traffic, but additional slot conflicts. On the other hand, peak-load oriented infrastructure charges contribute to avoid slot conflicts, but may be abused for monopolistic purposes.

7 Data requirements

7.1 Identification of relevant cost categories

7.1.1 Overview

In terms of getting hold on the various cost elements, there can be drawn a line between regular per kilometre costs like environmental costs, wear and tear and marginal costs of signalling etc. and costs that are functions of the whole railway activity. These **system costs** are typically congestion costs (delay) and accident costs. Based on variable quality of models in different countries, we do not propose a general methodology for the assessment of these costs, but refer to the cost calculation deliverables of IMPROVERAIL. Our general proposal for harmonisation of charges is to use SRMC-charging in all countries and include a surveillance organ and an information organ to control and increase the efficiency of these procedures. These organs are explained in section 7.5. The reason that we do not propose a clear way of assessing congestion costs is that we are not proposing a single track-allocation/ slot allocation procedure. As delays and accidents will vary according to the density as well as traffic pattern on the tracks, these costs are best calculated in combination with models for timetabling and track allocation. We believe that a surveillance organ will reduce the risk of hiding charging schemes departing from SRMC-pricing.

National valuations of these cost elements vary. **Variations in valuation** between countries are not regarded as a problem. Different charging practices in different states, is on the other hand a problem. This might lead to suboptimal incentives of routing of trains etc. **Charges may vary but charging principles should not.**

As seen in WP6, the costs incurred by the IMs are broadly related to the **initial capital costs** (depreciation and interests) for new investments and to running costs for **Maintenance**, **Management Administration** and, finally, to **Asset Renewal.** The definition for the latter is particularly relevant in this scope given that replacement of assets should be associated to major upgrades in the existing infrastructure, rather than with investment in additional elements of infrastructure, which should fall in the Capital Costs category.

The **Initial Capital** costs includes all the costs of buying/building the physical asset and bringing it into operation and may be divided into three sub-categories of cost, namely:

- Purchase costs include assessment of items such as land, infrastructure and superstructure, fees, furniture and equipment. Current costs may be estimated by obtaining quotations from suppliers.
- Finance costs include the cost effect of alternative sources of funds.
- Installation/ commissioning/ training costs: installation of equipments, construction of the infrastructure etc. and the costs of training personnel to operate the equipments and the infrastructure.

The **Maintenance Costs** include direct labour, materials, fuel/power, equipment and purchased services. Maintenance may be further broken down into smaller classifications such as:

- Regular planned maintenance
- Unplanned maintenance (responding to faults)
- Intermittent maintenance (for major refurbishment, other than renewals)

Presented below is a list referring to the Rail infrastructure cost estimation and the allocation process according to the HLG recommendations, which supported the identification of cost elements in the scope of IMPROVERAIL (see WP6 – Deliverable 8)

COST DEFINITION

Fixed costs:
- Land purchase
- Construction of new lines
- Upgrading/Enlargement of investments
- Overhead

Partly variable costs
- Replacement investments
- Construction maintenance
- Operation
- Servicing and on-going maintenance.

Pure variable costs:
- Security
- Scheduling/train planning

COST CATEGORIES
- Land purchase
- Construction of new lines
- Upgrading/Enlargement of investments
- Overhead
- Replacement investments
- Construction maintenance
- Operation
- Servicing and on-going maintenance
- Scheduling/train planning

COST DRIVERS
- **Train categories**:
- Freight trains (with sub-categories according to wagon load, combined transport, rolling road), Passenger trains (with sub-categories according to train type)
- **Network categories**:
- Electrified main lines, Non-electrified main lines, Electrified minor lines, Non- electrified minor lines (with further categorization according to type of traffic)

Furthermore, this HLG considers a division of the network into main lines and minor lines with a separate treatment of electrified lines. The minimum standard typology is defined as:

- Short-distance passenger transport,
- Long-distance passenger transport and
- Freight.

About Cost allocation, the HLG states: "It is possible to determine, which classes of wagons impose a particular damage to the track, and which (passenger/freight) demands different types of services. Whilst a detailed model linking costs to such relationships is ideal, the aggregated nature of most infrastructure

cost data implies that the top-down approach is more practical. Costs can be categorized and allocated or attributed according to general engineering relationship."

This may be seen as a key sentence with regard to the development of any information system, as in our view reflects what has long been the solution for the lack of detailed cost management information about the railway infrastructure. Although the mentioned top-down approach may solve some problems it may definitely become a second best solution when new technology and integrated information systems are available. This is, as already said, based on that the administration costs of an advanced bottom-up system are lower than the total system benefits of better cost-computations.

Delays and congestion costs

These cost elements are natural parts of any SRMC charging scheme. WP6 has more on this topic. Delays and congestion are system costs. It is difficult to measure these costs as the costs are functions of the total activity level and economical characteristics of the train causing the delay as well as other affected trains. Also congestion is a function of the total activity level. To complicate it even more, the costs are generally depending heavily on safety measures and block lengthsetc. Data requirements for these costs are thus linked to the way that track is allocated to operators. The best way to calculate these costs is to use national models that includes all domestic traffic and assess consequences on delays and congestions of marginal changes in activity. It is natural that these costs are calculated for minor subsections of track.

Accident costs

Accident costs are normally calculated as average per kilometre costs. This methodology seems reasonable and is also presented in WP6. Lowering expected accident costs might increase delays and level of congestion. Therefore: to measure these costs factors correctly demands a model that assesses the value of all traffic as well as the marginal costs of departing from schedule for all involved persons and vehicles.

Economic Principles and Cost Categories

According to economic theory and to EU-Directive 2001/14, rail infrastructure charging systems should reflect the (short run) marginal costs of use and may raise an additional capital cost coverage factor to finance partly or fully the residual costs. EU-Directive 2001/14 says that path conflicts in infrastructure bottlenecks have to be solved by auctioning mechanisms. In theory, in a well-designed auction scheme, the revenues of path auctions will reflect the scarcity costs or the opportunity costs of infrastructure bottlenecks. As auctioning systems are only possible in multi-operator environments, still rare in the world today, an alternative may be to perform a cost-benefit analysis (CBA) after setting the charges without the scarcity costs. In a well-performed CBA the best allocation should be revealed. Future infrastructure charging systems should incorporate the short run marginal costs (SRMC).

There are **some difficulties with the concept of scarcity costs**. In an auction procedure, the scarcity cost can be defined as the alternative value of a slot used. Also the value of the most valuable train that does not get the privilege to use the track can be called scarcity costs. In this way, scarcity cost reflects the cost of having limited capacity.

As a short term marginal cost component scarcity costs must be equal to the marginal increase in the average system costs of one more train being granted access to the track. Thus, scarcity cost is a component that consists of delay costs (we call it congestion costs) and increased average accident costs.

In systems where auction procedures are not the way that track is allocated, adding huge scarcity cost components is a highly questionable practice. We should remember that SRMC does not include components to finance long-term development of the infrastructure.

In addition, if political and financial decisions indicate a **capital cost coverage** factor might be added. As shown in preceding chapters, such elements that raise charges above SRMC will make the solution sub-optimal in terms of economic efficiency. **Even the most cost-efficient national railway system may still be unprofitable for a given output**. If authorities make political decisions on the level of provision of railway services, the effect of capital cost coverage factors may only be an equal rise in needs for subsidies. Therefore, in case of railway subsidies, high capital cost coverage factor will reduce public transfers to the IM but increase the subsidies to the operators. High capital cost coverage factors demand profitable TOCs. In this case, capital cost coverage factors are a way to transfer some of the operators' profit to the IM. In this case, the capital cost coverage factor must be set by a party that has the necessary knowledge to set the right charges.

Auctioning procedures might be used in multi-operator environments for allocating scarce capacity. Capacity at bottlenecks might be especially fitted for allocation by auctions.

The costs of accidents and the environmental externalities are also part of the social marginal costs. Frameworks wherein those externalities are estimated are needed in order for externalities to be internalised through charges.

The aim of the harmonisation of infrastructure charges is to adapt the existing charging systems to the system characteristics sketched above. This structural harmonisation is also expected to contribute to more transparency of charging systems in particular on a cross border contexts. Marginal costs are thoroughly discussed and explained in earlier chapters.

Assessing the relevance of different categories

Although the investment costs may be considered as the most relevant cost category when looking at the amounts involved, it is the component of "running costs", related to maintenance and normal operation, that should concentrate most of the attention of the information systems. In the end, these are the costs that can be controlled on a day-to-day basis, from which will depend the self-sustainability of the business operation. Besides, an in-depth knowledge of what is going in a systematic way represents an invaluable asset in order to minimise the overall lifecycle costs associated to the provision of infrastructure. These costs (borne by the IM) have been divided in WP6 as follows:

- Ongoing **maintenance costs** (those maintenance measures which have a life expectancy of less that one year and which are consequently not to be capitalised),
- **Operation costs** (for example: signalling, lighting, cleaning, personnel cost for switch-boxes at rail lines)
- **Administration costs**, mainly consisting of overheads of infrastructure providers, traffic police costs, traffic control, time tabling, planning.

The main driving factors for the ongoing maintenance are the maintenance standards (level of service), the maintenance philosophy applied, the level of technical progress and the climate conditions. For operating costs, the level of service and the institutional background (important for the level of personnel costs) are important driving factors. Institutional background influences administration costs.

Having determined the key causes of the various costs, it is clearly important from an efficiency perspective to be able to pass these costs on as closely and as accurately as possible to those who impose them. For rail, it is possible to determine which classes of wagons (according to weight and speed) impose a particular damage to the track. Whilst a detailed model linking costs to users through

such relationships is ideal, the aggregated nature of most infrastructure cost data implies that the top down approach is more practical. WP6 gives a framework for suitable cost categories. Again, we stress that it is only marginal costs and not the full costs that should be charged.

Furthermore, 3 main groups of factors may be distinguished that contribute to the deterioration of railway infrastructure:

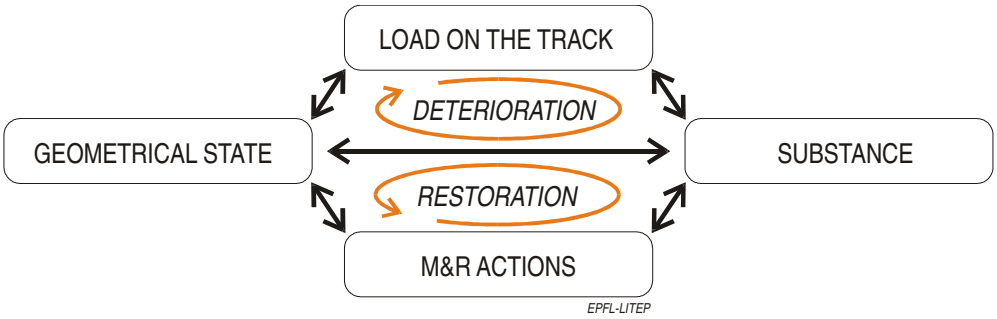
- Use: wear by physical contact, static and dynamic load
- Environment: climatic influence, water
- Failures: faulty components, bad construction

In accordance with the methodology developed in WP5, the deterioration of components mainly depends of the use, or load (traffic), namely on the track and switches. Therefore, a short overview of the deterioration process in relation to the life span is available hereunder:

Deterioration – Dynamic Restoration of the railways infrastructure under load dependent wearing

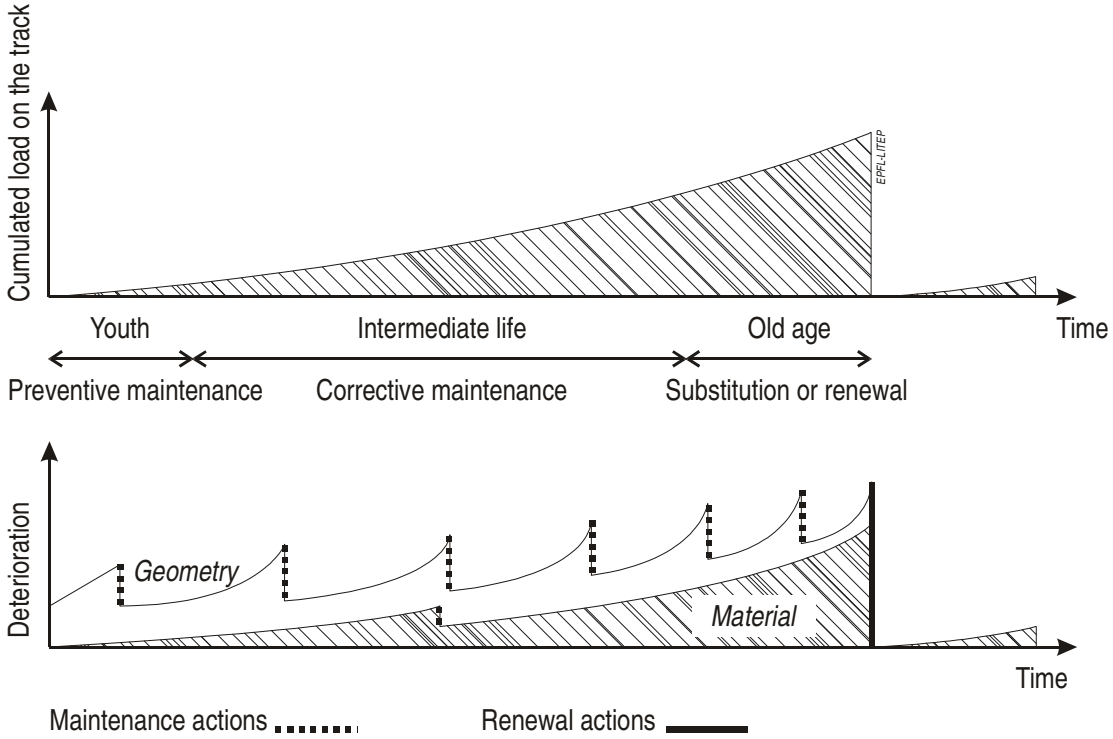
By far the most significant factor contributing to the deterioration is the dynamic load. The dynamic load is directly related to the axle load and track geometry. The two elements are closely linked in the complex process of deterioration:

Figure 8: : Restoration and deterioration processes



The deterioration of material contributes significantly to the deterioration of the track geometry, which in turn produces higher dynamic loads on the material, which accelerates the degradation of the material. The degradation curve of a generic railways track component is shown by the figure below.

Figure 9: Degradation and restoration processes of railways infrastructure with a load-dependent wearing



According to the figure above, the life of such components can be divided into three distinctive parts:

- **youth**
- **intermediate life**
- **old age.**

During youth, the component experiences substantial deterioration due to track settlements. After a while, the importance of degradations diminishes and the component starts its intermediate life. When reaching the end of its lifetime, the component undergoes higher degradations: it's the old age period.

A more accurate description of this topic will be available in the final reports for WP5 and WP6. For calculation of marginal costs of specific train types different models and practices are developed and are continuously improved throughout Europe.

Requirements for data quality and reliability

In the attempt to overcome flaws in the Information Systems, it is rather common to obtain proxies for Cost Assignment by means of Top-Down approaches in the absence of a better option based on suitable cost breakdown and correct assignment. In fact and since some costs may be fully assignable to specific activities/drivers while other costs, such as overheads, are hardly assignable in a fair and efficient manner to their effective cost drivers, costs are usually broadly divided in two categories:

- **Direct Costs**: costs that may be assigned with reasonable accuracy to the activities performed by the IM. All costs sharing this characteristic are able to support the grounded application of methodologies

relying on variability of the costs according to the level of activity and, ultimately, the thorough application of the marginal cost concept.

- **Indirect Costs**: this category comprises all the costs that for some reason such as lack of information cannot be assigned to the level of activities performed by the IM. Whenever the need for assignment arises, these costs are usually spread across several activities, most of the times based on a rough estimation of their relative contribution to their magnitude. When this happens, it is understood that the causal link between cost drivers and costs themselves is lost. Although usually supported by some statistical information or expert opinion, what in fact is obtained along this process may be seen as mere guesses, while the major risk is the fact that such guesses and their consequences tend to remain unchanged along the years, regardless of any changes that may occur in the railway system with an impact in the initial framework. A classical example of Indirect costs that usually play a significant role in the Railway Infrastructure are wages.

Again, see WP5 and WP6 reports for state-of-the-art of cost categorisation.

7.1.2 Regulatory environment

The way railways are organised affects how charging principles should be applied. Following are three archetypes of railways organisation

Three different regulatory regimes

The railway sector is, and will forever be, a sector that needs public control in order to function in a way that ensures efficient provision of railway services. This fact is related to:

- Externalities
- Limited competition
- Significant risk of harmful predatory behaviour between market contestants
- Building and designing railways, station areas etc. affects land use and urban planning to an extent where public participation in the decision process is absolutely necessary.

These points are independent of profitability and ownership of railways.

In addition: In most railway systems, one or more of the following elements create needs for public regulation of railway activity.

- Price regulation of end-user prices in order to ensure end-user welfare. Price regulation may have many different motivations, such as interregional equity, maximum price regulations etc.
- Price regulation of infrastructure services. These regulation of these prices may be caused by political will to ensure non-discriminatory treatment of different operators as well as wishes to maximise the number of operators on track
- Public funding of investments in railways
- Indirect public funding of railways by guarantying the conduct of IMs or operators
- Public responsibility through ownership of railway entities
- Politically set levels of railway services, which normally will lead to a need for subsidizing specific routes.

The list could be made even longer. The important lesson to learn is that no matter how advanced and competitive a specific railway industry is, the first set of bullets will always apply. There will always be important externalities in production and consumption that needs proper regulatory measures in order to be internalised. There will also be, linked to the huge investments needed in order to provide rolling stock, necessary certificates etc. room for only a handful competitors within a market. Therefore, the need to ensure that market power is not exploited through cartels etc. will always be present. Finally, there will be a need for surveillance of all railway units, also IMs, in order to ensure that operators are handled in a non-discriminatory way.

There are different ways of performing this public control. In pre-reform environment, prices and activity were regulated directly:

$S_1 = S(\overline{p}_s, \overline{x}_s)$

Here S represents the social value of the railway activity, taking both consumer surplus and producer surplus and all externalities into account. $\overline{p}_s$ is the vector of all politically set prices. This function was maximised given financial conditions etc. This practice has been rightfully accused for not give good incentives for cost-minimisation and to be regulated by too many political aims. The government is the actor that maximises this function

Vertical separation of the railway industry, has for most countries lead to this situation:

$$S_2 = S\left(S_{IM}\left(\overline{\Pi}_{Oi}\left(\overline{p}_s, \overline{p}_f, \overline{x}_s, \overline{x}_f\right)\right)\right)$$

In this situation the social welfare is secured in two steps:

First the infrastructure managers, being public or semi-public have the right to set some of the charges for the operators and perform within different business activities. The government controls the overall activity, and is usually the party that decides on the level of PSOs (x_s), and juridical and organisational decisions in the railway industry. The operators are free to set some prices and the activity on some lines up to a certain level (x_f,p_f). This is obviously a more complex system, increasing the complexity of the task of regulating the railways. The "administration cost" of the railways may therefore have increased. On the other hand, the performance of operators has increased dramatically. Also IMs tend to be more effective than before, especially in countries where the IMs are free to make profit. If S_2 is nearer to the true social optimum than S_1 taking changes in public expenditures on regulation into account, has not been proven - only made probable. It is difficult to say in which way prices, output and regulations should be altered in order to make the system altogether run the best way, but progress has been made in the past decade that shows that a new era has started.

A third possible regulatory environment can be drawn:

$$S_3 = S\left(\Pi_{IM}\left(\overline{\Pi}_{Oi}\left(\overline{p}_s, \overline{p}_{IM,}\overline{p}_f, \overline{x}_s, \overline{x}_f\right)\right)\right)$$

Here the IM is profit maximising, and the government ensures the social welfare. This solution may seem more plausible and simple than S_2, but the number of factors that needs to be controlled by the regulator increases dramatically. The main problem is that a monopolist IM has an incentive to cooperate with one operator in order to function as an integrated monopolist. It can be shown that a situation with one IM and one operator is inferior to an integrated monopoly both in respect to producer surplus and consumer prices. (Tirole J. (1990)) Public transfers to operators will directly enter the IM's profit function, and the IM

might be able to set prices in a way that maximises public transfers. Obviously, this leads to a sub-optimal situation.

The latter regulatory environment (S_3) is thus only an interesting solution if:

- The railway industry as a whole is profitable without public transfers. Even the most cost-effective railway industry may still be unprofitable. So, increased cost-efficiency is not enough to conclude that railways will be profitable in the future. In many countries the railways may never reach a size and standard where end-user payments will be larger than the total costs.
- The operators function as a competitive market, with limited market-power for all contestants.
- The IM's activity can be controlled by the authorities

Conditions 1 and 2 are usually not fulfilled even for most advanced railway systems. Profit maximisation demands profitable railways, and this is unfortunately a rare event. Condition 3 will probably demand a lot of public effort, which should be added to the cost- side when calculating costs and benefits of these different systems. If public transfers are given to the railway sector, for operation of for investment in infrastructure, a profit maximising IM is not a good solution. This deliverable suggests a general methodology to be applied in regulatory environments of type 2 and type 3 or somewhere in between.

7.1.3 Operators' share of infrastructure investment costs – additional cost recovery

Many countries demand a fee from operators in order to finance parts of the infrastructure costs. In this deliverable, we conclude that such practices are in general not recommendable. Short run marginal cost should be the base of the charging system. If such transfers from operators to IMs is necessary due to limited will or ability to grant public funding, this section gives some guidelines in how to design this money flow system.

Charging principles should be set in a way that takes all the following aspects into account:

- Efficiency, incentives
- Equity
- Justice
- Transparency
- Non-discriminatory

The three latter aspects are related to how the charges are published, and how they vary between operators. The two first principles are directly affected by how the charges are set.

Additive contribution – worst case in terms of efficiency

An additive component to the SRMC is the worst way to collect a financial transfer in terms of efficiency. This method changes the relative prices between different routes, and thus leads to sub-optimal traffic allocation. This is most severe for the routes with the lowest SRMC, thus traffic reduction is most likely where the costs of the traffic is lowest. In terms of equity, this methodology is basically appropriate.

Multiplicative mark-ups to SRMC – a better solution in terms of efficiency

A multiplicative factor to the SRMC will not distort the relative prices between routes. The direct substitution effect is therefore zero. The price level increases, so the number of routes that the operators will afford to run for given revenue is reduced. The operators will have to choose between reduced profits or increasing prices for end-users. Usually, the result will be somewhere in between. This result depends on the properties of the end-users' demand functions. The elasticity of demand will determine how much of the prices can be paid by the end-users. It is an inevitable fact that higher charges than SRMC will lead to reduced and sub-optimally low supply of railway services, either by reduced activity of the operators, or by fewer operators on track. So, if the aim of social planners is to maximise the market share of the railways, SRMC should be chosen and financial components in the access charges be set equal to zero.

Ramsey pricing – best solution in terms of efficiency

Ramsey pricing, explained in chapter 4, is a methodology for minimising the consequences in terms of reduced demand for a given charge increase. Weighting the price increase on each route by the elasticity of demand will distribute the different contributions to the routes where demand is least affected. The logic is simple: Those that are less sensitive to price increases, are punished hardest, while those that quickly change their behaviour will face smaller increases in prices. This is the optimal procedure of collected a given amount of money in terms of efficiency. Equity is on the other hand strongly affected. Some end-users may have no other option than to use the railways, and if Ramsey rules are applied the fares can increase dramatically. Also public transfers like PSOs are troublesome.

Two-level charges

An alternative to charging the operators per kilometre is to introduce a fixed sum to be granted access to the infrastructure and then use ordinary SRMC afterwards. The entrance fee is motivated as cost coverage for the infrastructure investments costs. This method has some advantages. First, SRMC-pricing of the use of infrastructure secures incentive-neutrality. The fixed sum that the operators must pay, makes the risk of excluding newcomers from market entry more obvious. Visualising these costs in this way shows clearly that pushing capital costs of infrastructure over to operators is not congruent with the wish to increase the market share of railways. Although two-level pricing seems feasible in the timetabling process, two-level charges seems less well functioning to handle occasionally journeys, and additional journeys to schedule.

7.1.4 International traffic

International traffic and SRMC

International traffic creates some problems of allocation of capital costs to operators that run only occasionally on the network. The capital cost coverage factors that these operators face must be linked to the level of use of the network on a short-term basis. The most appropriate way should therefore be to use multiplicative charges to the SRMC.

International traffic makes charging more complex. IMs can take three different roles in the process of providing paths for international rail carriages: Origin IM, Transit country IM and Destination country IM. SRMC-based railway charges should be allocated to each of these IMs according to the SRMC-charges that apply for the different routes. Marginal congestion costs should of course also be included, and as a first adaptation, a mark-up matrix for city-areas and rush hours is recommended.

It is essential to make these costs visible for the operators before the actual journey is undertaken.

International traffic and charging regimes

There are a number of different charging regimes in practise. Those systems may be affected by the implementation of recent EC directives. However there are no activities in the member states that actually reflect a change of charging systems towards directives 2001/12-14. Derived from this situation one might call for a harmonisation of the charging of cross-border traffic. Our recommendation is not to have similar charges in different countries. Cost structures, level of external costs and density on track are all variables that vary among countries. National charging principles should on the other hand be equal or at least adaptable.

We suppose that the transparency of national charging systems is given if they are published on paper and on Internet. The criteria freedom of discrimination is fulfilled if (1) different TOCs have not to pay different charges without the reason of cost differences and (2) procedural aspects provide a maximum of transparency to all TOCs acting in or entering the market of rail services.

Unfortunately the complex combination of different charging systems with numerous differentiators makes it very difficult for TOCs to adapt their operational variables to the optimal ratio of operational benefits and infrastructure charges. Therefore we need some recommendations on how to improve the transparency of charges for cross-border traffic. Transparency will be improved if the IM reveal the sensitivity of charges according to operational parameters such as alternative times (off peak), alternative loads, alternative routings, alternative speed, alternative loads and so on. For this purpose the IM should build priorities by which change of an operational parameter the most savings can be achieved. In cross border traffic, the aim of the one-stop IM responsible for acquisition of the access rights will have to aggregate the potential savings.

In section 7.5 we have some proposals that might create an easier environment for operators seeking increased international activity.

7.2 Data assessment

Differences in national subsidies or in the degree of the internalisation of external costs might lead to inefficiencies in the use of rail networks. Ceteris paribus TOCs prefer networks more subsidised and with less internalisation of externalities.

Moreover, differentials in the internalisation of external costs result in similar effects as differentials in subsidising networks. Basic internalisation standards may contribute to avoid unfair competition between network operators. However this is a task of the overall European environmental policy. External costs should be treated in a similar way for all modes of transport. The part of the induced external costs a traveller must bear should be equal for all modes.

From the point of view of TOCs who are interested to offer a service on a specific track, the following data requirements are necessary to plan and develop such a service:

1. The actual capacity utilisation per route and for different times that should be published for each track by anonymous time-utilisation-schemes in a transparent way. This would allow new entrants to identify opportunities for new train services
2. The technical restrictions (cf. the following section)
3. The prevailing scheme governing infrastructure charges.

From the point of view of an IM it is also necessary to forecast the potential delays per route and per different times to incorporate them into his service level agreement with the TOC. Moreover he needs an

overview of delay cost estimates in order to assess potential penalties and to incorporate them into the overall infrastructure payment system.

Technical restrictions

Vertical separation of the railway sector has many benefits, but also some drawbacks. One major drawback is the increased difficulty of cost – linkages between track and train. Wheels damage track and track damages wheels, but the IMs and the operators have in a pure competitive environment little motivation for reducing the costs that are borne by the others. An integrated railway company had a more straightforward optimisation problem when choosing materials and equipment to find the optimal mix of investment cost and maintenance and renewal costs. The new environment demands that the total system costs are taken account for by the different parties. This can be done in two ways. Either by cooperation or by incentive mechanisms that secure this issues to be taken account of. In small environments, cooperation will probably be the best solution, while incentive mechanisms are the best solution in advanced, complex markets of larger scale.

Cooperative solution

Tracks and rolling stock are stable assets. New investments are done in a pace that gives time to find system solutions using the knowledge and opinions of the different parties involved. Normally this includes IMs, operators and the government. In such environments the best solutions to a minimum of administration costs could be found.

Network capacity can be regarded as the ability of the infrastructure to provide a seamless path through time and network over track whose technical characteristics match the need of the train to be run. So not only has there to be a slot, also limiting technical aspects have to be respected:

- axle load
- maximum train length
- maximum speed
- inclines
- braking ability
- loading gauge
- type of electrification (incl. none)
- type of train protection

Incentive mechanisms

In a complex market, with many operators and train types, the cooperative solution may not apply. In this situation a system where the different characteristics of trains are published, and where these characteristics are linked to charges schemes that incorporate the system costs. The track's characteristics should also be published, but these costs are internalised by the operators in their decisions about running on the tracks. We propose a special international organ for this purpose in section 7.5

Each IM has to publish these characteristics for each section of his network in the network statement. This allows the TOC to adjust their rolling stock and to make slot requests, which are not to be rejected immediately for technical impossibility.

When processing the slot requests the IM has to take into account these technical capacity restraints, meaning that not all trains can be displaced onto alternative routes even if they connect the origin and the terminus of the path requested.

Within most national networks the type of train protection and electrification is uniform over the network. In contrast the train protection system is different across European countries and the type of electrification changes at most borders.

Additionally administrative rules have to be respected

- drivers licence
- technical certification
- safety certification
- scheduled restrictions
- prioritised connections in international traffic.

All in all, technical and administrative aspects of the network are necessary data requirements for the planning and development of new services. Therefore the IM has to identify and declare those restrictions in a transparent and discrimination free manner.

Data existing in practice

In practise different charging systems make use of the relevant cost data to a different degree. Table 10 gives an overview on what data are used for a sample of actual infrastructure charging systems:

Table 8: National comparison of cost categories used

Cost category used for charging system	A	B	D	NL	N	P	RO	CH
Wear and Tear	X	X	X	X	X			X
Train Control			X	X		X		X
Maintenance			X		X	X	X	
Cost of Capital			X(2)			X		X
Costs of avoiding path conflicts at short term		X	X	X				X
Costs of avoiding path conflicts at long term	X(1)							

(1) Under consideration; (2) only implicitly incorporated

Some IMs are running commercial accounting systems as Quo Vadis (NL) or SAP (NL, P, D). In these cases the quality of available data is assessed to be sufficient. Some IMs as in Norway or Germany are using own LCC models to assess the costs of wear and tear. Some have precautions to develop and establish new accounting models with external support (RO). Therefore the quality of existing data is presumably not sufficient. Development of cost methodologies is performed in many countries, and IMPROVERAIL has made a contribution to give the European railways a new tool for designing such cost schemes and for comparison of cost categories, structure and level between countries.

Analysis of data sources

For the assessment of cost components different information systems are used. Some systems are standard accounting systems, some are simulation systems and some are based on more or less regular studies carried out by accountants and consultants.

The data sources mainly allow the identification of cost categories and the allocation of specific costs. However, the allocation of overhead costs follows different principles that cannot be analysed from an outsiders´ point of view. Moreover, even the different definitions of cost categories used in practise make it uneasy to get a harmonised input into cost data sources.

What is still missing in the existing data sources is the linkage of cost to the benefits of certain infrastructure managing activities. For example, the use of specialised railway snowploughs imposes costs to the IM, but creates benefits to all TOCs in winter times. However, if the benefits of the TOCs are unknown IM will reduce investments in such equipments to the damage to the overall system quality. Therefore it is necessary to establish Service Level Agreements in order to internalise such benefits (or damages) in the non-cooperative system.

Data reliability and comparability

Different principles of cost data identification used in practise are not sufficient to explain the differences in infrastructure charging systems. Even comparing charging systems, which are mainly based on the same cost elements such as Germany, Norway, Netherlands and Switzerland, differ in the level of charges to a high degree. Those differences cannot be explained only by geographical differences, for then the charges of Switzerland should be much higher then the German charges. On the other hand, the differences also cannot simply explained by the different incorporation of the cost of capital.

All in all the comparability of the existing data is bad and cannot be improved without a specific benchmarking process or by comparable substitutes (e.g. yardstick competition). On the other hand, the low level of data comparability is also based on different cost allocation principles. For that problem, a better transparency of infrastructure charging components could increase the performance of all infrastructure charging systems and the performance of planning cross border-train services.

7.3 Implementation Options for Slot Allocation

As described in chapters 5, 6 and 7, there are **different levels of complexity** in possible charging procedures. Ambitious planners may want to implement advanced system in an early phase, while others may have a conservative attitude, only doing what is demanded through approved directives. There is a **link between regulatory environments and cost categories** needed, as well as which charging principles that are functional. The functionality of the chosen regulatory environment is also depending heavily on the underlying **economic characteristics of the market.** When choosing a regulatory scheme for a specific railway industry, one has to take many elements into account.

The following procedure is a procedure suggested by this Work Package, as a procedure that we believe will function in the typical European railway environment. Sections 5.2 and 7.1 deepen our view on which practices are recommendable for charging the infrastructure.

7.3.1 Example of a possible slot allocation regime

This chapter contains a short description of a methodology for infrastructure charging and slot allocation. It is not the most advanced system that could be developed. On the contrary: It forms a basic framework that might avoid some of the market failures, sub-optimal solutions and awkward results that may have come from a too hasty introduction of advanced infrastructure charging

This report does not recommend one single methodology for the process of slot allocation and timetabling, but a number of conclusions are drawn, enabling us to suggest ways to go in European railways. Some different systems are proposed, and the systems are designed to show how we are able to include new parameters in the charging procedure by increasing the complexity. Our main conclusion is of a rather simple system that is of such kind that it should be possible to adapt it to all national railway environments.

The background of the railway system for which the methodology is designed is the national railways reforms, partially as a result of EU legislation, partially a result of national initiatives. The EU directives state some minimum level of development of the railway systems in Europe. As has been well described in other parts of the IMPROVERAIL project, the national railway systems show variety among a number of dimensions. What has been implemented throughout Europe is the separation of infrastructure manager (IM) and the national railway operator. In some cases the IM has kept a close connection to the government, while in order to motivate competition, the operator has been made economically responsible. Within this framework all facets can be found in Europe. Our main suggested methodology fits best, where the IM at some extent can take other aspects into consideration than profit maximisation. Also with a profit maximising IM a charging procedure can be introduced. Such a market would need extensive control from a public organ, securing the welfare of the passengers and the public as a whole.

The main conditions for this framework to function is:

- Infrastructure charges set by an organ securing public interests rather than own profitability
- No financial flows between government and any operator. If so, do not let this company use its financial advantages to destroy any attempts for competition

Some pitfalls that will erode the benefits from any commercially oriented systems are:

- Too high level of cost-coverage of the provision of infrastructure. Most car users never pay for the road that they drive upon. Until then, neither should the railway passengers. The need for a certain level of cost recovery is understandable. It is in general better to tax the companies' income, rather than a kilometre-dependent charge. This element creates a spike between the optimal charge and the actual charge, and thus induces a too low level of railway service production.
- Too much use of PSOs. PSOs should be used when railway services on some lines are socially profitable but not commercially profitable. Of course, if few lines are profitable, no market really exists, but as external conditions as technology, jurisdiction as well as the demand structure changes and evolves, new lines may become commercially viable. Then, the use of PSOs should be reduced. There is a risk that PSOs may function as a pillow, avoiding the stride to increase productivity.
- The authorities must ensure that international external conditions are set in such a way that international traffic faces the correct set of prices and as little bureaucracy as possible. National protectionism is a loss for all.

The methodology can be described as having two main stages:

First stage: Set the infrastructure charges

Charges should be set equal to the short run marginal cost. The cost structure should include costs as wear and tear of track and signalling, but also external costs as noise and pollution. The congestion cost is a continuously changing function in time and space. For practical purposes we suggest a simple mark-up structure to be used in areas with congestion. Second-best considerations may be used, if based on proper analysis. Second-best charging is a good way of avoiding too high rail-tariffs compared to other modes of transport.

Add national financial mark-ups. Off course, the combination of second-best pricing and infrastructure-financing components is contradictory.

Add national time-dependent mark-ups to deal with congestion in the rush hours. Hence, this mark-up is predetermined at a one-step or multi-step level in this simple model. It is an estimate and not a market solution. Note that congestion charges will improve the system's efficiency while financial mark-ups will undermine the efficiency.

Make this regime (all national charging regimes) transparent to all parties, domestically and abroad.

The capacity is at all times regarded as the feasible capacity given national and international regulations on safety etc.

Second stage: Design the timetable:

At the stage of setting the timetable, there are multiple successive steps that must be taken.

1. Set the framework for the timetable. Define the total capacity on each line, taking into account the linkage between density on track and safety, reliability and expected number of delays as well as impacts of delays.
2. PSOs are the first type of departures to be set in the timetables. PSOs are first placed in the timetables without auction. The government is the purchaser of the PSOs. The government should be as flexible as possible in terms of time-slots for these trains. The PSOs have to be set in a transparent and discrimination free procedure. The PSOs can of course be distributed in a "competition for the track"-system, but if the government already runs a railway company it seems reasonable to give these contracts to this company.
3. Long distance departures, international inter-city passenger traffic and transit trains are then adapted into the timetable. As far as networks are dedicated to long-distance traffic those relations should even have the priority.
4. Some corridors for freight are established mainly outside of peak-hours in order to ensure efficient international freight traffic. The freight trains should not come in conflict with any commuter train services etc.
5. At this stage, if the organ that sets the time table can cooperate with the purchaser of PSOs, the PSOs may be adjusted slightly in order to improve the timetable
6. Packages of slots, offering specific train products on specific networks are sold to a company – if possible by some kind of auction. This procedure is chosen, as there will generally be economies of scale in serving a certain region or passenger group in a certain area. Therefore letting different companies serve the same passengers with the same services might reduce overall efficiency. Avoid direct competition on track for similar services. Different packages could be like: City - commuter westwards Capital – Large city Intercity trains
7. The remaining slots are kept for a slot market for anyone to compete. The entrants must pay the same charges as in step 1 as well as the increased system delay costs that the newcomer pushes upon the others. This charge is paid to the IM, even though the operators are the ones suffering.
8. This timetable is set for some predefined period of time. Adjacent countries would benefit from designing their national timetables simultaneously. This is a condition for ensuring this methodology to function
9. A second-hand market is established, in order for any pareto-improvements to be revealed.

A slot is the right to run a specific train at a specific line at a specific time. It is also **a duty.** This is absolutely necessary on order not to end up in a situation where one company strategically buys several slots to be left unused by itself but inaccessible to its competitors.

Equally important is the transparency of all processes in the timetabling procedure. There should be no need to keep things secret. On exception might be the bidding procedure, where closed bids might be used. But this does not contradict an open, non-discriminatory process.

Conditions for procedure 1

Vertical separation. No money-flows from IM to operators

IM takes social welfare into account.

SRMC-pricing plus eventual mark-up (capital cost coverage factor)

Subsidises of operators are not recommended. PSO-contracts is a typical way of subsidising the ancestor of the old railway company. This might be reasonable if the government is financially responsible and if the government has better cost-control of this company in terms of what are the true costs of running the PSOs.

7.3.2 Description of other methodologies

Procedure 2: the German system

First the IM publishes a general infrastructure charging system and a "network statement" describing the state of infrastructure and external timetable restraints, e.g. from European timetabling. Based on this the TOCs plan their services and form their slot requests to the IM, at the latest 8 months before the next change of timetable. The IM processes (sorts) the path request by internal rules, partly given by public law. Without conflicts, the timetable can be produced. In case of conflicts, the IM can reject certain conflicting slot requests or propose altered routings. If the TOC accepts the alternative routing(s), the timetable can be produced. If not, a round table of IM, TOCs and the authority (Eisenbahnbundesamt) is organised as a kind of mediation process. If the round table comes to a common solution, the timetable can be produced. If not, the EBA has to decide if one service is to be classified as regular service whereas the conflicting service is an irregular one. In that case the regular service would have the priority. If none or both services are regular, the final allocation has to be decided within a bid process.

Two necessary, but not sufficient conditions for this system to be optimal are:

- the social value of regular services exceeds the value of competing non-regular trains,
- the WTP of competing TOC´s reflect the WTP of the end users.

The second condition might be not fulfilled if the market for rail services is distorted by near-monopolistic behaviour of an incumbent firm or by cross-subsidizing of a vertically integrated firm. Therefore a certain degree of competition, a vertical disintegration of railway companies and a suitable regulatory environment are necessary preconditions to lead to a social optimum.

Procedure 3: An auction system

This system might be as explained in section **5.2.6 "Model for Slot Allocation"**

7.3.3 Data requirements as a function of Slot Allocation Regimes

The three systems described above are not only different in terms of slot allocation criteria but also in their specific data requirements. The next table provides an overview on the data requirements resulting from such different slot allocation regimes:

Table 9: Data requirements from different slot allocation regimes

Data required	Procedure 1	Procedure 2	Procedure 3
SRMC	Yes	Yes	Yes
Data for financial mark ups	No	Yes	Yes
Data for congestion mark ups	Yes	Yes	No
Technical restrictions	Yes	Yes	Yes
Punctuality requirements	Yes	Yes	Yes
Economic benefits of PSOs	Yes	Yes	No
Economic benefits of long distance traffic	Yes	No	No
Economic benefits of freight traffic	Possibly	No	No
Maximum of payments through all bids	No	No	Yes

7.3.4 Implementation Options in Cross Border Contexts

Cross Border Traffic Context

Within the EU all railways hold a market share of 16% in freight transport by land in 1995, the share had dropped to 13% by 2000. Road transport carried 76% in 1995 while 8% of the European cargo was transported via inland waterways. Interestingly the railways had a slightly stronger position when only cross-border traffic is regarded; here they carried 20% of all goods (road 59%, inland waterways 21%). Over the last decades rail's market share steadily decreased which is true for national and international transport. A major reason for the international market share being better is that the railways have a structural advantage in long hauls, which naturally cross borders more often. Also the railway's strong position in cross-alpine relations helps explaining the fact. According to Faulhaber [FAULHABER 2001] the market share in 1992 was 49% in the Germany←→Italy market, 64% for Belgium←→Italy and even 76% for Sweden←→Italy. In 1996 45% of all rail freight traffic within EU was cross-border traffic.

International rail transport is still ruled by the national networks. As mentioned, technical characteristics differ between the networks and require the use of multi-system rolling stock or the change of rolling stock at the border. Timetable planning is carried out individually which results in long waiting times at border stations. The average speed of cross-border rail freight is at 18 km per hour and its market share continuously declining.

European corridors:

Each system of slot allocation might work to a certain degree at the national level. However such systems cannot afford the slot allocation for international services. Therefore an international co-ordination is necessary as well as a reservation of some corridors for international traffic prior to timetabling national slots.

Today international paths are planned within the Forum Train Europe (FTE). FTE coordinates the national timetable planning by holding three conferences before a new European timetable becomes effective. Within FTE "capacity managers" shall plan, coordinate and allocate paths and solve conflicts independently from the train operators. FTE facilitates to request international ad-hoc paths over a single IM. Members of FTE are the former national railways and the IMs.

An example of pre-planned international corridors is the European Freight Freeways ("Freightways"). One of the many aspects they were created for is that they run on internationally coordinated paths which have a higher average speed than common international trains. The paths are timetabled and usage can be requested shortly before departure depending on availability. For more details see 6.3.3.

The Freightways shall be developed into a bigger Trans European Rail Freight Network (TERFN) which covers many of the EU's principal rail lines. But until today it is only planned to grant open access on the TERFN. No measures to assert high quality paths for freight are yet decided. Directive 2001/14 only calls for cooperation among the national IMs in the case of international paths. In the long run it will be necessary a) to set incentives to national IMs to establish Freightways and b) also to set up rules to co-ordinate traffic at those Freightways in cases of path conflicts.

7.4 Contractual Relationship and Harmonisation of Charges

7.4.1 Service level agreements

The term *quality* is widely used in most markets offering services or goods for consumers. The transport sector is no exception; choosing between different modes of transport or between different companies includes choosing among vectors of many different quality aspects.

Often the term *quality* is used for all characteristics that are not included in the price of the service or good. Using this interpretation, quality may appear to have no relevance for business decisions. This point of view is false. One has to separate between quality aspects for which there is potential willingness to pay (WTP), that is the consumers are better off consuming the good or service with more of that specific quality parameter, and quality parameters for which there is no WTP. (The latter is probably no quality parameter at all).

Having defined quality, the next question will be for whom the quality parameter is relevant. The obvious and most common actor is the consumer. The consumer has certain preferences for a wide number of quality parameters, some that are purchasable in the market, and others which will affect his decision making without directly affecting prices and yet others which the consumer just has to take for granted. Three examples from the railway sector follow. An example of the first type is the quality of comfort (which itself probably is a bundle of a number of different quality aspects like space, air conditioning etc). The traveller may choose a business-class ticket in order to enjoy more comfort, whereas travel speed, frequency and risk of delays obviously is the same as for the passengers sitting in a regular compartment. An example of the second type is choosing between different modes of transport. Having the choice between two train departures with the same price, same travel time etc, might still involve considerations of differences in quality level. An example of quality aspects of the third type is quality aspects that are technologically or practically impossible.

Customers of railway services can in different ways include quality in their decision-making behaviour. Thus the implicit valuation of different quality aspects can often be derived from market data. The most common way for the economist to include quality aspects is by making the quality a good itself. Then, the

quality aspect can have its own price and the demand for this good can be measured in a regular way. Normally, it is impossible to reveal the valuation of quality aspects from real market data, but through different kinds of stated preference methods the valuation of quality parameters can be estimated.

In a non-commercial market with regulated activity, the planner might take account for different quality parameters. In a way, the social planner can act upon one kind of stated preference method: the expert opinion.

In a deregulated market with increasing level of competitive behaviour, quality parameters for which the companies are unable to charge for will stand in risk of disappearing. This can lead to sub-optimal situations and the need for regulatory interventions.

Security, safety and environmental concern are typical quality aspects that the travellers are concerned about.

How to measure quality?

Different ways of measuring and controlling quality aspects are

- Benchmarking – use of indicators to compare with other competitors or time-series of own performance
- Standardisation
    - Company standards
    - National standards
    - European standards
    - World standards (ISO…)
- Quality auditing
- Customer satisfaction surveys

Quality vs. Service level

Service level agreements (SLA) are in this report, defined as some kind of contractual agreement between operators and government or infrastructure manager on the **minimum service level** that the operators must provide for the end users (passengers and freight shippers), and on the service level that the IM will provide to the operators. Off course, also other service level agreements may be established, e.g. between operators and end users by long-term contracts etc, or between operators. As infrastructure managers to an increasing extent are commercially responsible, the operators might find it even more important to define specifically what services the IM will provide for the next years etc. As we see there are two important levels of service level contracts:

1. Contracts between Infrastructure manager and government. Generally, as the IMs in Europe are becoming less dependent of governmental transfers, the regulator might wish to influence on the way that the IMs is acting. This, in order to secure public interest. Normally, the IMs are acting in a public or semi-public environment where public interests are accounted for. Thus, the regulatory environment will determine whether contractual agreements must be set on this level.
2. Contracts between infrastructure manager and train operator. This is the kind of contracts that are studied in this report. Considering the different relevant areas to regulate by contract, one might be able to on a general level give some indications on importance of service level contracting.

Four different kinds of quality measures can be distinguished. Two of these measures are consumer related and the other two are service supplier related:

- Expected quality - Customers' expectations
- Perceived quality - Measurement of customer satisfaction
- Targeted quality - Companies' strategy
- Delivered quality – Benchmarking, Quality level auditing

Expected quality is the quality standard that consumers expect ex ante their consumption of the service. Perceived quality is the quality level the consumer experience consuming the service.

Targeted quality is the company's strategic level of quality. Of course best quality is never expected, as this is generally not optimal in a cost-revenue considerations or socio-economic decisions. All companies will of course aspire to the best bundle of quality assets for given investments. The quality parameters perceived by the consumers are often not identical to the quality delivered by the company. And the delivered quality of the services is generally not equal to the quality level that the company has aimed at.

7.4.2 Contract Types

The following two types of contracts refer to service production contracts, often used in tendering procedures.

1. **Gross cost contract**: The operator is paid an agreed price for the production of a determined level of services, and revenues accrue to the authority. Production risk is thus covered by the operator and revenue risk by the authority
2. **Net cost contract**: The operator is paid by the estimated difference between operating costs and revenues for a given level of service. Both revenue and production risks are covered by the operator.

These two regimes have different incentives. The net cost contract is better than gross cost contracts to motivate for increasing market shares (competitive behaviour).

Tendering is a method of competition **for** the market. The one that wins the tendering bidding process, will for some period of time have some privileges like public transfers, grant of access to a certain network etc. In tendering there is a risk that *procedural fairness* is distorted. The credibility of each tender needs to be analysed, so that unfair strategic bidding is detected and avoided.

In contracting the fairness of the final solution must be considered. Elements to consider are

- Incentives and motivation for efficient production
- Incentives and motivations for competitive behaviour
- Division of risk between operator and regulator
- Division of profit between operator and regulator
- Consequences of incapability of delivered the agreed services for the regulator (IM)
- Consequences of incapability of delivered the agreed services for the operator(s)
- Possibility to renegotiate contract if needed for operator
- Possibility to renegotiate contract if needed for IM
- Considerations of the agreement's consequences for future tendering rounds

All these elements should be analysed before the final contract is signed.

A typical tendering process consists of some or all of the following steps:

1. Construction of tendering offer
2. Tendering delivered
3. Tendering bids received
4. Credibility of bids analysed
5. (Possible sequential bidding procedure)
6. Winner of tendering contract announced
7. Contract
8. Tendering period of varying duration (1 year up to 20-30 years)
9. New tendering period prepared. Construction of tendering offer

The majority of the steps, step 1-7, are related to the tender contracting procedure. Step 8 and 9 are directly affected by the result of the contracts.

Quality parameters are not visible

Some quality parameters like punctuality and reliability are visible to other parties. Other quality aspects are not so directly observable. Examples are processes affecting safety and environment. In such situations there is a risk that somewhere in the production process the quality is deliberately lowered, since others may not detect this quality reduction. Of course, the motivation for this is that keeping up a high level of quality is expensive, at least in the short run. This kind of situation is by economists referred to as *moral hazard*. The workers in the company providing the services may slacken the quality of their work, as the quality cannot automatically be checked and therefore be adjusted to the proper level. This will lead to discrepancy between officially targeted and delivered quality. Also between regulatory level and market participants there is a risk for lowering of quality level in order to increase profit and short-term competitive power relative to competing companies. Agreements, contracts and standards are ways of securing the quality level delivered. These can be done by either a system of punishing the companies if quality is delivered below some predetermined level or by creating some kind of operational measure for quality that can be observed and surveyed. Also combinations of these methods can be applied.

The company must aim at a level of quality that

- Meets standards and requirements of Company level, National, European or of global origin
- Will meet the expectations and demands of the consumers. Depending on services from competing firms in the same market or from alternative markets and the quality experienced earlier.

Service level contracts are not special to the railways. On the contrary, it is relevant for all commercial markets, where quality level is not immediately observable for consumers or when temporary monopoly status is granted by means of tendering (consumers have no other supplier to go to).

Tendered contracts are examples of service level agreements. Public Service Obligation contracts (PSOs) are often specifying frequency etc. which sets some general level of quality of the services the operator provide, and with a threat of holding back revenue if the standards are not meet.

Defining quality is a heavy task. Quality goes along many dimensions. The matrix presented in table 24 is a good example of a reduction of quality standards into main components.

Building up a Contractual Relationship based on the WTP principles

As seen in chapter 5.1 and 5.2 it would not be much help for the IM if it only knew the WTP for exactly the requested slot, because it is unlikely that the IM can realise a slot without any alteration. The IM rather has to know how the TOCs WTP changes with alterations of the slot – the operators elasticity –, e.g. for earlier or later departure time, longer travel time, different routing. WTP then is a function of all aspects of the slot, primarily of the time-related aspects.

In general freight slots are considered to have a lower price-elasticity in departure and arrival time then passenger trains, with the only exception of logistic trains, which have a low flexibility (high elasticity) because they have to be timed on the production process they supply.

Pre-sort of WTP with slot products

Quality differentiation is way to pre-sort the operators' WTP prior to slot allocation. In most cases the WTP for a slot will rise with the slot's average speed. It will also rise when a higher level of punctuality is guaranteed. High-value passenger services will show an extra WTP for clock-face departure times or undercut of key journey times (e.g. 3h29' between Berlin and Frankfurt/M). For revealing the operator's WTP the IM can tailor slot products that incorporate different combinations of slot qualities and charge different prices for the different products. The operator can choose the product that matches the value of his train and from the products chosen or not the IM can conclude on the operators' WTP for different aspects of the slot. The EU-project Quattro suggests the following public transport quality matrix:

Table 10: The quality matrix

1. AVAILABILITY
    a. Network
    b. Timetable
2. ACCESSIBILITY
    a. External interface
    b. Internal interface
    c. Ticketing
3. INFORMATION
    a. General information
    b. Travel information – normal conditions
    c. Travel information – abnormal information
4. TIME
    a. Journey time
    b. Punctuality and reliability
5. CUSTOMER CARE
    a. Commitment
    b. Customer interface
    c. Staff
    d. Physical assistance
    e. Ticketing options
6. COMFORT
    a. Ambient conditions
    b. Facilities
    c. Ergonomics
    d. Ride comfort
7. SECURITY
    a. Safety from crime
    b. Safety from accident
    c. Perception of security
8. ENVIRONMENT
    a. Pollution
    b. Natural resources
    c. Infrastructure

Source: Quattro (1998)

These 8 categories adds up to the main components of quality for railway services. Each component can be further divided into subcomponents and each subcomponent may be operationalised to a measure that can be monitored, continuously or regularly, in order to check that eventual quality level agreements are fulfilled.

7.4.3 Need for division of responsibility between IM and operator

Provision of good quality has a cost for the service provider. The profit-seeking firm must have all relevant quality parameters included in the tendering contract etc. in order to ensure that all parties are contented with the service level experienced later.

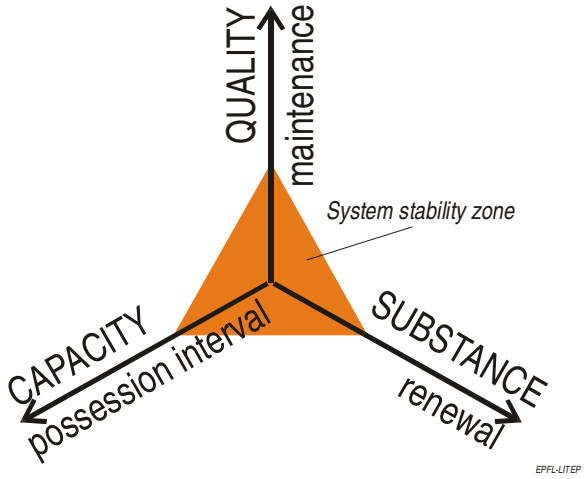
Depending on the regulatory environment the IM or the authorities may undertake a cost benefit-analysis in order to assess the social optimal level of service provision. The benefit of specifying all quality parameters is that the cost function of each quality variable in order to avoid over- or under-investments of one or more quality aspects. As the aggregate level of outsourced services rises, so too does the potential for the IM to lose control of service quality. By specifying expected quality by contracts, the risk for accidents and delays etc. can be reduced.

7.4.4 Planning the infrastructure maintenance and renewal: Contracting

Outsourcing over extended time periods infrastructure maintenance and renewal becomes frequent. It has the advantage to create competition, driving down the costs and improving the quality. Innovative procedures come to light: automation of labour-intensive tasks, more efficient management, … Contractors are committed to maintain the network condition throughout the contracting period, being free to define their maintenance policy.

This is not fully sufficient to ensure network durability. As a matter of fact, geometric condition of the track may be kept through efficient maintenance and without renewal. By doing so, infrastructure grows older and older, and the requirements for corrective actions increase exponentially. Eventually, the network experiences shortage of maintenance equipment, and capacity losses as well, that lead to system imbalance. Pushed to the limit, maintenance of the network is not possible anymore and speed restrictions become unavoidable. To revert from such degradation, huge investments are needed over short time periods, and this is never a pleasant situation. The figure below indicates how quality, substance and capacity are interlinked in a way that these aspects cannot be separated in long-term planning. The IM must keep the long-term effects of maintenance and renewal activity performed, either by the IM or by outsourced contractors, so that responsibility for the long-term value of the assets are not deteriorated onto a number of units.

Figure 10: Three dimensions of maintenance and renewal



Consequently, infrastructure managers must remain in control of the medium- and long-term maintenance policy, even if maintenance is outsourced. They must set frame conditions that force the contractors towards an acceptable mix of maintenance and renewal.

IMs are outsourcing maintenance services in order to generate competition, but there is an obvious need to set up medium- and long-term maintenance policies to ensure sufficient renewal rate of infrastructure.

As Gordon (2000) states it "If a contract is silent or unclear about an agency's requirements with respect to quality, timeliness, or responsiveness to customers' needs, the work performed may fall short of the agency's expectations."

One technique to find measures that can be used in order to document the quality of services delivered, is by benchmarking. By a benchmarking procedure, measures can be found that are suitable as measures for predefined quality level for a service level agreement.

The provision of services has gradually been dispersed on many different dependent, independent, private, public, semi-public, specialized or general units performing different tasks and providing different services needed in order to provide passengers and freight forwarders the service paid for. This dispersion of control on to a large number of different units demands a system where the following questions are clarified.

- Who has the responsibility of offering the service
- When should the service be delivered
- What is the service level that should be offered
- What happens if we fail to deliver this service on time

Three vital dimensions of service level agreements

1. **Price**
2. **Quality standard**
3. **Incentive/ penalty system**

These three dimensions are interrelated. High demands of quality will increase the costs of providing the services. New investments in equipment or rolling stock or increased number of employees may be necessary in order to be able to adapt a higher quality standard. This will naturally lead to higher production cost of services, and thus lower value of the contracts offered from the authorities.

An incentive/ penalty system is needed in order to reduce the risk of strategic behaviour, where the quality of the services is lowered after the contract is won, and thereby increase profit.

Through auctioning of tenders/ franchises with detailed prescriptions of quality standards, the services provided can be secured, but there is a risk that equally good or even better quality levels could be reached by a lowering of some standards and increasing of others. By letting the bidders give offers of both price and quality standards the different technological characteristics of the companies can be revealed and thereby reach higher efficiency in the production process. But of course, the comparison of the bids becomes more difficult and subject to litigation.

7.4.5 Quality control schemes from around the world

Australia and New Zealand

The urban rail system in the Melbourne region is an example of a fully competitive railway system, and is therefore an interesting study case. The system was completely franchised to the private sector in 1999, with two separate 15-year franchises. For other Australian systems the systems continue to be operated by public authorities or corporations, through negotiated contracts/ agreements with varying levels of details and formality. The contracting system in Melbourne is among the most sophisticated systems worldwide. In part it is based on the UK train operating (TOC) franchises, but adaptations to the Melbourne system have been undertaken.

Main payment component is the net annual subsidy, which was the focus of competitive bids: this covers both capital and net recurrent costs, and generally reduces year-by-year over the franchise period. In addition, there are passenger-related payments for concession travel reimbursement and for passenger growth above a threshold, and a system of incentive/penalty payments relating to operating performance (see below).

Other Australian Systems. Payments are negotiated, based essentially on: either net costs, in those cities (Sydney, Brisbane) where rail has its own fare system; or gross costs, in these cities (Adelaide, Perth) with integrated multi-modal fare systems.

New Zealand. Both systems essentially have net cost contracts.

Quality and incentive/ penalty systems

Melbourne has the most elaborate system, both of quality standards and of penalties/incentives relating to performance relative to these standards. The standards and incentive/penalty systems cover:

- Operational performance: reliability (cancellations, short trips) and punctuality (early and late running)
- Customer satisfaction, as measured by a composite index, assessed through random telephone interviews.

Quarterly payments to/from each franchise have ranged up to some A$1.5M. Further, unsatisfactory performance may be grounds for early contract termination.

In addition, a passenger compensation code applies to holders of periodical tickets (4 weeks or more) where punctuality and reliability fall below threshold levels, and to individual trips in cases of disruption of services and inadequate information.

- Other Australian systems. All these systems have quality standards. Adelaide, Brisbane and Perth also include financial penalties for poor performance.
- New Zealand. Both systems have a range of quality standards, but no separate incentives/penalties (beyond the effects on fare revenue). However, in Auckland persistent failure to meet standards is a factor influencing early termination of contract or consideration for future contracts.

Contractual agreement for future development

- **Melbourne**. Minimum service levels are set by Government (as at start of franchise). Some service enhancements were also incorporated into the franchise conditions as an outcome of the bidding process. Franchisees are also required to increase service levels as necessary to cater for increased demand (to meet specified loading standards). Other service enhancements are at the discretion of the franchisees. Maximum fares are regulated by Government: fare increases are generally not to exceed CPI increases.
- **Other Australian systems**. Service development is generally a joint responsibility between the Government authority and operator, but with Government having the final say. Setting of (maximum) fares is primarily a Government responsibility.

MELBOURNE – DETAILS

A - Funding Basis

- Base subsidy (lump sum) payments for each year of franchise based on net cost (capital and operating) bids, allowing for allocation of revenue between operators. Payments generally reducing over franchise period (become negative in one case).
- Concession travel reimbursement, relating to concession ticket-holders carried at reduced or free rates.
- Capital grant funding – pre-specified amounts relating to new/upgraded infrastructure and rolling stock, over franchise life.
- Passenger growth incentives – additional per passenger payment for patronage greater than 10% above the level at the start of the franchise.
- Incentive/penalty payments under Operational Performance Regime (OPR).

B - Operational Performance System

Loading Standards: Set of maximum loading standards, related to vehicle capacities.

Operational Performance Regime (OPR): Set of defined thresholds for proportion of 'lost' services, 'early' services and 'delayed' services. If these thresholds are exceeded in any reporting period, this constitutes cause for 'call-in', 'franchise breach' or 'termination event' (depending on extent and duration of deficiency). Complex OPR incentive/penalty system based for each quarterly period, based on:

(sum of passenger weighted minutes relating to cancellations, short trips, delays and early running) less performance target

multiplied by

Specified value per passenger weighted minute.

Delays etc caused by the actions of other franchisees, by Government actions or resulting from force majeure events may be excluded for calculation purposes.

Penalty payments under CSI (below), expressed as % reduction in annual payment, are based on proportionate shortfall of CSI score relative to defined threshold score.

C - Customer Satisfaction Index

Defined a Customer Satisfaction Index, covering customer satisfaction with key service aspects, including service delivery, rolling stock comfort, passenger information, stations, ticketing arrangements, complaints handling, staff attitudes.

CSI score determined through a random telephone survey of 1,700 passengers, spread evenly over the year.

Continued poor performance under CSI, relative to defined thresholds, may constitute a 'call-in' event or franchise breach

D - Passenger Compensation Code

Franchisees are required to have a Customer Service Charter and Passenger Compensation Code, relating to service reliability and punctuality, and to report monthly to passengers on their performance.

Where performance is below the defined thresholds, franchisees are required to compensate (usually with complimentary tickets) those passengers holding periodical tickets (4+ weeks validity) for the month in question. Compensation may also be payable to all passengers affected by non-performance, without adequate information, on individual trips.

THE NETHERLANDS

In a "memorandum of understanding" signed September 2000, the Dutch railway authorities and the operator NS agreed in a new quality contract. Regarding punctuality it was agreed that customers should be in position to expect that trains arrived and departure on time. Therefore, good punctuality should not be rewarded, but bad punctuality be sanctioned. Originally, these measures of punctuality were negotiated. The percentages refers to trains which are less than three minutes delayed according to schedule on 34 points of high importance. The measures are the average of multiple countings.

Table 11: Punctuality agreement in the Netherlands

Year	Minimum percentage delayed less than three minutes on 34 predefined points in the railway network
2001	88
2002	89
2003	90
2004	91
2005	92

In 2001 the level of punctuality was approximately 80%. The level of ambition was therefore lowered to 80% in 2001 increasing to 89% in 2005. From 2003 the operator must pay Euro 450.000 for each tenth of a per cent lower result than in the contract, with a limit of Euro 11.25 million which corresponds to a punctuality 2,5%-points lower than targeted. As an indicator of these charges, NS produced 129 million

train kilometres in 1999. (Source: UIC) So, the fines correspond to approximately Euro 3.5 per train kilometre. In addition to this agreement, the passengers suffering from severe delays shall be granted compensation. This reimbursement shall be 50% of the ticket price in case of delays between 30 and 60 minutes, and the whole ticket price for longer delays. Finding an agreement between NS and the IMs (Netherlands has a system of multiple units responsible for railway related services. For more information read Improverail Deliverable1) on how to share these costs is given to NS. The punctuality achieved must be published every three months. If punctuality falls below 3%-points below the standard, NS must present a plan for the authorities describing the causes of delays and ways to solve these problems.

UK – United Kingdom

Strategic Rail Authority (SRA), the railway regulator in Great Britain, has an incentive system including punctuality and reliability.

- **Punctuality incentive payments (PIP).** The operators' punctuality and reliability is measured by a "benchmark" which normally corresponds to the level of punctuality before the franchise contracts are settled. Better punctuality leads to a bonus and poorer results leads to fines. The benchmark level is an annual mean value, so that it is expected that bonuses and fines varies systematically with time of the year.
- **Timetable Change Incentive Payment (TCIP).** Operators are punished if route plans are changed according to the printed schedule. This system is introduced in order to motivate operators to get better control with planned/ expected deviations from schedule, by setting the TCIP lower than the PIP. This is passenger-friendly, by making more cancellations known in advance, although they are not written in the schedule.

These agreements are independent of who that causes the delay. The operators have separate agreements with the IM Railtrack. These agreements distribute economical responsibility between all parties. The following table shows the money flow between the operators. Separate incentive agreements between the operators and the Passenger Transport Executives are not included.

Table 12: Charges/ rewards for punctuality (PIP) in 1000GB£**

Operator	April 2000-March 2001	April 2001-March 2002
Anglia Railways	42	-162
Arriva Trains Merseyside	-837	-923
Arriva Trains Northern	-7,434	-5,594
c2c –869	-1,232	-192
Central Trains	-8,084	-8,430
Chiltern Railways	-301	-534
Connex South Eastern	-8,663	-3,438
First Great Eastern	-4,453	-2,615
First North Western	-2,100	-3,024
Island Line	-39	-12
ScotRail	-3,429	-8,822
Silverlink	-1,843	-772
South Central	-7,664	-4,695
South West Trains	-10,563	-10,951
Thames Trains	-3,267	-3,248
Thameslink	-2,715	-2,470
WAGN	-5,788	-7,119
Wales & Borders	n/a	-670
Wessex Trains	n/a	-1,620
Total	-71,287*	-67,064*

** Operators and Authorities are negotiating on new measurement methods for punctuality, and the new guidelines will lead to revision of older data. Thus, these figures may be altered in future.*

*** Positive figures indicate bonuses from SRA. Negative numbers indicate fines from SRA.*

Operators are obviously not the only entity causing loss of punctuality; therefore also operators and Railtrack need contract agreements. Then, operators are able to claim the IM for any incidents that are infrastructure-related. The following table shows one example of such contracts.

Table 13: Example of transactions between operator and infrastructure manager on different levels of punctuality

Punctuality, per cent	Payment, £1000/year	Comment
98 or better	250	
97	150	From Operator to IM
96	50	
95	0	
94	0	No rewards/ punishment
93	0	
92	0	
91	50	
90	100	
89	150	
88	200	Payment from IM to operator(s)
87	250	
86	300	
85	350	
84 and below	400	

This table shows a targeted punctuality level of 92%-95%, which is a rather broad target, making the system less sensitive for random variations. This system has the right incentives for the IM. This is very interesting: The operators face direct contact with end users and experience reduced demand and reduced consumer goodwill if punctuality is low, thus the incentives for the operators are strong in order to minimize number of delays. The IM has on the other hand has often not the same close link to end users, so increasing the IM's motivation for high punctuality can increase the overall system efficiency dramatically.

NORWAY

Through Public Service Obligations (PSOs) the Norwegian authorities are giving the operator[2] some quality demands such as frequency of services during weekdays and weekends, and peak hour capacity measured by number of passenger seats. Also some regulations on fares and especially on different kind of rebates (military, season tickets etc) are regulated. Regularly, NSB must report their performance to the Ministry.

Hopefully, the further harmonisation of the European railways will reduce the National variations, and thus making contracting and regulatory environment more similar.

As far as passenger rights are introduced into the European railway system it has to be ensured that the TOC are not finally responsible

a) for delays caused by the IM (which are approx. 50-75% of all delays in German railways)

b) for delay caused by other TOCs.

[2] NSB AS, the only company with PSO-contracts

7.5 Recommendations for harmonisation of charges

Chapter 7 identifies initial capital costs and maintenance costs as the main cost elements in railway infrastructure management. According to their nature they can be divided into fixed or variable costs, where some costs are dependent on the rolling stock using the infrastructure. Infrastructure charging systems should be based on short run marginal cost pricing. With this charging principle, the initial capital costs are not covered by the operators. Some countries may demand some cost recovery of the investments by an additional element added to the SRMC. We have stressed that this practice causes a spike between the cost of providing the railway services, and the price that the operators pay. This leads to sub-optimal provision of railway services. A general fee for the right to provide train services, paid annually etc. would be a better way in terms of efficiency. This practice will also show in a better way that the provision of additional contributions from the operators may reduce the number of operators as well as the total railway activity. On the other hand, this method would have increased welfare transfers between countries in international traffic.

In a new competitive market with increasing decentralization, the need for creating a system with correct incentives for all actors is vital. This report has given some examples of what quality measures are of high relevance for such contracts. Some guidelines on how these contracts should be designed and some examples from around the world are given. As no national railway system is similar as well as no National jurisdiction and regulatory environment is equal, there is a need for encompassing and making adjustments in order to fit into another countries' contract. Hopefully, the further harmonisation of the European railways will reduce the National variations, and thus making contracting and regulatory environment more similar.

Transparency for all parties is a very crucial requirement for all infrastructure management activities. Based on transparency TOCs are able to develop, plan and improve own services without causing unnecessary path conflicts. Transparency helps to avoid path conflicts before they emerge. TOCs should be able to assess the economic impacts of certain decisions by route, time and choice of equipment.

Current practices in Europe, vary significantly between European states. This leads to tremendous variations in infrastructure charges. Although most countries are using the SRMC principle, the practice of adding capital cost coverage factors to these charges leads to charges that are far from the true SRMC. In addition; the real SRMC might be very different between states and should therefore vary.

The railways across Europe have been subject to change, from integrated organisations closely related to governments into several split bodies, increasingly separated from governmental control. While the Council Directive 91/440 changed the basic organisation of railways, other measures were put to place furthering the objectives set. The Railway package (esp. Directive 2001/14) is the most topical one, which is to be implemented in 2003. It has implications for infrastructure charging systems, slot allocation mechanisms, the institutional independency of slot allocation from transport operation and for the regulation of the sector. With respect to the slot allocation problem it is relatively open to the criterion, which can be used for solving path conflicts. Three systems for charging were presented in chapter 7.3. Those systems naturally have different data requirements:

Table 14: Data requirements from different slot allocation regimes

Data required	Procedure 1	Procedure 2	Procedure 3
SRMC	Yes	Yes	Yes
Data for financial mark ups	No	Yes	Yes
Data for congestion mark ups	Yes	Yes	No
Technical restrictions	Yes	Yes	Yes
Punctuality requirements	Yes	Yes	Yes
Economic benefits of PSOs	Yes	Yes	No
Economic benefits of long distance traffic	Yes	No	No
Economic benefits of freight traffic	Eventually	No	No
Maximum of payments through all bids	No	No	Yes

As we see there are two important levels of service level contracts: a) Contracts between Infrastructure manager and government. Generally, as the IMs in Europe are becoming less dependent of governmental transfers, the regulator might wish to influence on the way that the IMs is acting. This should be done in order to secure public interests. Normally, the IMs are acting in a public or semi-public environment where public interests are accounted for. Thus, the regulatory environment will determine whether contractual agreements must be set on this level. B) Contracts between infrastructure manager and train operator. This is the kind of contracts that are studied in this report. Considering the different relevant areas to regulate by contract, one might be able to on a general level give some indications on importance of service level contracting.

7.5.1 How can data requirements and information systems be harmonised at EU level?

This report recommends SRMC-pricing without financial mark-ups. This point of view seems not to be shared in all European countries at present time. Agreeing on a common pricing methodology would seriously improve possibilities for international railway traffic. This demands an EU legislative framework for implementing a similar charging methodology across Europe. Much is done in the railway package currently implemented, but a close control with the development of the European railway systems by both regulatory organs as well as by R&D programmes seem necessary.

As we have proposed, the charging methodology should be equal across Europe, while charges are free to vary as long as these variations are based on proper calculations of underlying cost differences. For example, external costs have presumably a lower valuation in Eastern Europe. All local emissions must be given a cost level that relates directly to local valuation, normally separated by country. There is one important exception. CO_2-emissions have global rather than local impacts, and should therefore be charged equally in all countries.

Operators must give information to the relevant bodies about all train specifications needed. At the same time information about the track should be ready for the operators. The information organ might provide the operators this information.

Proposition for implementing marginal cost scheme

The European Council must develop the legislative framework needed in order to ensure that a well-functioning and non-distortive charging procedure is used in all European countries.

There is a line that must be drawn between regular railway systems and special-designed railway systems as high-speed lines like the TGV and different light-rail lines. For this infrastructure, a vertical separation may not always be recommended. Competition on track may also be unfavourable in some such systems.

Tear and wear can, as described in WP5 and WP6, be calculated by top-down approaches as well as bottom-up approaches. A well-designed LifeCycleCost (LCC)-model could easily verify a reasonably reliable top-down-calculated tear and wear measure. A bottom-up approach seems like a superior methodology in terms of assessment, but there is a risk of calculating a far too high cost level, accidentally or intended, by adding all kinds of minor cost components and unconsciously fall into situations of multiple counting of the same items . A top-down approach may be a good way to ensure that the tear-and-wear calculations are not exaggerated. Off course, accounting principles used and accounting practices used limit this approach. Data requirements should concentrate mainly on the feasible output of information systems and not on the technical system characteristics. As the development of railway accounting systems are evolving rapidly, standards for how such calculations should be performed may be introduced in few years.

Every IM has to implement an information system that is able to produce all relevant cost types. IMPROVERAIL has created tools to aid the IM with this task. Also new software increases the ability to assess all relevant cost types in a good way. The data have to differ along all facilities listed in Annex II of Directive 2001/14 and they have to reflect the overall aims of the Directive, which is a discrimination-free and efficient use of the rail infrastructure.

System costs is the main problem for a full SRMC-scheme. System costs are mainly related to delay costs and congestion costs. These costs need to be assessed in the timetabling procedure, and then be allocated in a fair way. This is a heavy task and approximations must be done. We propose to introduce a surveillance organ that ensure that the national calculations are done fair. The consortium expects that

The main requirement for fully assessing delay costs and congestion cost is an advanced computer program that is able to assess consequences of delays and mishaps on all parts of the infrastructure. This program must include all activity on track. Also elements of system costs exist in maintenance, as maintenance normally demands blocking a part of the infrastructure. Such costs could and should be analysed as well in such models. The rate of development of available software is very rapid, and the gap between the most advanced IMs to the less advanced IMs in terms of using such software becomes bigger. We expect this process to converge.

Proposition for Surveillance Organ for Charging and Timetabling

We propose that an organ is established to audit national cost calculations in order to reveal charges that depart from correct charging principles and cost estimates.

This organ should have the necessary authority to perform this audit and secure that reactions are taken whenever errors are found.

In addition to the surveillance of the charges set by the national infrastructure managers, this organ may also monitor national timetabling procedures. The consortium is less conclusive about which timetabling procedures to recommend. For example, in densely populated areas with heavy traffic, capacity maximising policies by the IM may stand in the way for some potential market entrants. As such system benefits and system costs are difficult to calculate, we will not draw strict conclusions about what is good and what is not. Obviously, the IM must be open about what allocation rules apply. This is covered by the general need for **transparency**.

This organ may also look for state-of-the-art processes at different IMs, and through counselling with the European commission, such processes may become recommended practice.

7.5.2 What are the specific data requirements related to international traffic?

Proposition for Information Organ for Railway Operators and Infrastructure Manager

We propose that an organ, different from the Surveillance organ, is established, in order to provide the operators information about free capacity on all European networks, information about charges and functioning as a representative for international operators concerning allocation of track in national timetabling rounds.

Based on operators' requests to this central organ, this organ will be able to represent the operators in a good way.

Timetabling should be done on a national level, although we have stressed the benefits of simultaneously setting of timetables in neighbouring countries. The information organ can represent foreign operators and help these operators to get a fair treatment in the national timetabling procedures.

The two organs proposed established will be helpful for international railway carriers to plan and perform cross-border journeys. Increasing international traffic sets high demands on data needs and information systems. As different train sets have different impacts on each other, tear and wear costs will vary from train type to train type and between different track qualities. As we have described, internalising these costs through infrastructure charges will give operators the right incentives for replacement and investments of track, and the operators the right incentives to choose train types for different paths.

International traffic increases demand for fair treatment of transit operators as well as transit countries. Per kilometre charges secures that each country can be compensated according to the costs borne.

In order to avoid favouritism of domestic traffic and operators (This might especially be a problem related to transit traffic) equal charging principles should apply for national, international and transit trains of similar characteristics.

Data needs and information systems in the near future

Under market pressure and due to Directive 2001/14, we expect that IMs will develop a more disaggregated view on their costs related to different services to TOCs. This means that data needs as well as information systems will become more complex within the next five years.

As the market become more disaggregated and complex, the need for clear demands on necessary **statistical information** becomes ever more vital. Regulatory organs, control organs and researchers need to have detailed information about the market available.

7.5.3 Data reliability and data validity

Data reliability as well as data validity might be a problem. The legislative framework stated in directives should secure the latter. Different ways to calculate cost elements may cause great differences. Further R&D in combination with new software is needed to help IMs and operators to assess the SRMC elements. Reliability can be a problem for different reasons:

- Calculation errors
- Statistical deviations
- Strategic decisions

System costs are costs that are functions of the total traffic systems. The main components are congestion costs and delay costs. Also scarcity costs are relevant, when it comes to slot allocation procedures. These costs are also the hardest to assess. We refer to other parts of the IMPROVERAIL project for state-of-the-art calculations of these cost types. It is only external costs that are relevant for infrastructure charging.

There is always a risk for wrong figures for multiple reasons as described above. Therefore it seems necessary to have "systems in parallel" that can control the data proceeded by the national IMs. One such organ is the surveillance organ, already described. Continuous independent R&D-activity will limit the IMs ability to departure from pricing principles over time. Also national differences in understanding of rules and regulations will be revealed by such studies.

Policymakers and regulators are not able to fully overcome the natural information asymmetry against the regulated firms. Therefore regulatory economists have developed a set of light-handed instruments for regulation. Those instruments set incentives to behave as efficient as possible without pulling the regulator into the procession of huge amount of detailed data.

One instrument to support the theoretical pricing mechanisms with grounded data is the harmonisation of data quality. Another instrument is to oblige IM to publish a yearly report on the implementation of marginal cost principles as a necessary precondition for any state aid/subsidies. This instrument allows a better benchmarking of individual cost allocation policies and different pricing policies across Europe.
Last but not least EU policy should clearly indicate under which conditions (freedom of discrimination, proof that money is used in the best alternatives, yearly reports to the public, establishment of performance regulations etc.) IMs can receive subsidies for infrastructure investment and management, and how these subsidies can be given.

The consortium recommends national detailed models able to assess system costs for the use of calculating system costs as well as allocate track efficiently. Gradually, as the technology evolves, such systems can be made mandatory for all countries.

In Chapter 7 is shown a visible gap between data requirements for harmonised infrastructure charging in theory and practise even if it takes into consideration that the need for such harmonisation can be limited to the principle of transparency. The following table gives an overview over which theoretically required cost data are used in practise:

Table 15: Comparison of National cost categories used for charging principles

Cost category used for charging system	A	B	D	NL	N	P	RO	CH
Wear and Tear	X	X	X	X	X	X	X	X
Train Control			X	X		X		X
Cost of Capital			X			X		X
Costs of avoiding path conflicts at short term		X	X	X	X			X
Costs of avoiding path conflicts at long term	X(1)							

(1) under consideration

What is generally missing in the existing data sources is the linkage of cost to the benefits of certain infrastructure managing activities. If the benefits of the TOCs from certain IM activities are unknown the IM will reduce investments in such equipments to the damage to the overall system quality. Therefore it is necessary to establish Service Level Agreements in order to internalise such benefits (or damages), or some cooperation between the different parties must continue.

In a new competitive market with increasing decentralization, the need for creating a system with correct incentives for all actors is vital. This report has given some examples of what quality measures are of high relevance for such contracts. Some guidelines on how these contracts should be designed and some

examples from around the world are given. As no national railway system is similar as well as no National jurisdiction and regulatory environment is equal, there is a need for encompassing and adjustments in order to fit into another countries' contract. Hopefully, the further internalisation of the European railways will reduce the National variations, and thus making contracting and regulatory environment more similar.

As far as passenger rights are introduced into the European railway system it has to be ensured that the TOCs are not finally responsible

a) for delays caused by the IM

b) for delays caused by other TOCs.

Last but not least the actual transparency of the network use and of free capacities is crucial for TOCs to develop and introduce new train services. From the point of view of TOCs who are interested to offer a service on a specific track, the following data requirements are necessary to plan and develop such a service:

1. The actual capacity utilisation per route and for different times. This should be published for each track by anonymous time-utilisation-schemes in a transparent way. This would allow new entrants to identify opportunities for new train services
2. The technical restrictions (cf. the following section)
3. The infrastructure charges.

From the point of view of an IM it is also necessary to forecast the potential delays per route and per different times to incorporate them into his service level agreement with the TOC. Moreover he needs an overview of delay cost estimates in order to assess potential penalties and to incorporate them into the overall infrastructure payment system.

For international traffic even the transparency of infrastructure charges (sensitivity to operational parameters of the TOC) should be improved.

Commercial IMs demand public control. The consortium suggests establishing strong and independent regulators at the national level. This requires:

a) the establishment of regulators who ensure the efficiency of infrastructure charging systems, either by approving those systems or by setting up an incentive regulation such as price-cap regulation / rate-of-return regulation, yardstick competition and efficient sanctions to the management. The aim of such regulation is to ensure static and dynamic (investment) efficiency. Public money spent to the operators or to the IM should not be absorbed by the IM but transformed into a better performance

b) the development of service level agreements to realise qualitative efficiency

c) the development of state aid control at the European level to ensure that the market conditions of infrastructure managers and TOCs are not perverted by extensive national subsidies into the network. This aims at fair competition within the common market

Public IMs might be less proactive in terms of market development. Public IMs might also be suffering from political control rather than aiming at efficient pricing. On the other hand, the public IM will probably design a charging system that is dedicated to maximise efficiency rather than profit. The demands for governmental surveillance and control should therefore be much lower, and thereby increase efficiency for the operators and low public expenditure on surveillance and control. Deregulating the IM will not necessarily lead to increased efficiency in the market; increased governmental control must follow such decisions.

The socio-economic success of those systems depends on the efficiency of regulation and on the degree of competition between TOCs. Presumably this degree of competition will be sufficient mainly for relations in and between urbanised regions. Regulation of the IM has not only to ensure the discrimination-free access to path capacity at earlier stages of implementation but also the right incentives to the IM to realise static, qualitative and dynamic (investment) efficiency.

8 Recommendations and conclusions

As the market become more disaggregated and complex, the demand for reliable information becomes ever more vital. Regulatory organs, control organs and researchers need to have detailed information about the market available. Under this market pressure and due to Directive 2001/14, we expect that IMs will develop a more disaggregated view on their costs related to different services to TOCs. This means that data needs as well as information systems will become more complex within the next five years.

In practice different charging systems make use of the relevant cost data to a different degree. In table 9 an overview was provided on what data are used for a sample of actual infrastructure charging systems. It was seen that some IMs are running commercial accounting systems as Quo Vadis (NL) or SAP (NL, P, D). In these cases the quality of available data is assessed to be sufficient. Some IMs as in Norway or Germany are using own LCC models to assess the costs of wear and tear. Some have precautions to develop and establish new accounting models with external support (RO). Therefore the quality of existing data is presumably not sufficient. Development of cost methodologies is performed in many countries, and IMPROVERAIL has made a contribution to give the European railways a new tool for designing such cost schemes and for comparison of cost categories, structure and level between countries.

For the assessment of cost components different information systems are used. Some systems are standard accounting systems, some are simulation systems and some are based on more or less regular studies carried out by accountants and consultants.

The data sources mainly allow the identification of cost categories and the allocation of specific costs. However, the allocation of overhead costs follows different principles that cannot be analysed from an outsiders´ point of view. Moreover, even the different definitions of cost categories used in practise make it uneasy to get a harmonised input into cost data sources.

What is still missing in the existing data sources is the linkage of cost to the benefits of certain infrastructure managing activities. For example, the use of specialised railway snowploughs imposes costs to the IM, but creates benefits to all TOCs in winter times. However, if the benefits of the TOCs are unknown IM will reduce investments in such equipments to the damage to the overall system quality. Therefore it is necessary to establish Service Level Agreements in order to internalise such benefits (or damages) in the non-cooperative system.

But different principles of cost data identification used in practice are not sufficient to explain the differences in infrastructure charging systems found. Even comparing charging systems, which are mainly based on the same cost elements such as Germany, Norway, Netherlands and Switzerland, it is easily concluded that they differ to a high degree in the level of charges. Those differences cannot be explained only by geographical differences, as then the charges in Switzerland should be much higher then the German charges. On the other hand, the differences also cannot simply explained by the different incorporation of the cost of capital.

All in all the comparability of the existing data is bad and cannot be improved without a specific benchmarking process. On the other hand, the low level of data comparability is also based on different cost allocation principles. For that problem, a better transparency of infrastructure charging components could increase the performance of all infrastructure charging systems and the performance of planning cross border-train services. In this sense, data reliability as well as data validity might be a problem.

Different ways to calculate cost elements may also cause great differences. Further R&D in combination with new software is needed to help IMs and operators assess the marginal cost elements.

Policymakers and regulators are not able to fully overcome the natural information asymmetry against the regulated firms. Therefore regulatory economists have developed a set of light-handed instruments for regulation. Those instruments set incentives to behave as efficient as possible without pulling the regulator into the procession of huge amount of detailed data.

An instrument to support the theoretical pricing mechanisms with grounded data is therefore the harmonisation of data quality. This instrument allows a better benchmarking of individual cost allocation policies and different pricing policies across Europe.

The consortium recommends national detailed models able to assess system costs for the use of calculating system costs as well as allocate track efficiently. Gradually, as the technology evolves, such systems can be made mandatory for all countries.

To this respect a visible gap has been shown between data requirements for harmonised infrastructure charging in theory and practice even if we take into consideration that the need for such harmonisation can be limited to the principle of transparency. Table 16 "Comparison of National cost categories used for charging principles" provides an overview over which theoretically required cost data are used in practice.

It was seen that what is generally missing in the existing data sources is the linkage of cost to the benefits of certain infrastructure managing activities. If the benefits of the TOCs from certain IM activities are unknown the IM will reduce investments in such equipments to the detriment of the overall system quality. Therefore it is necessary to establish Service Level Agreements in order to internalise such benefits (or damages), or some cooperation between the different parties must continue.

In a new competitive market with increasing decentralization, the need for creating a system with correct incentives for all actors is vital. This report has given some examples of what quality measures are of high relevance for such contracts. Some guidelines on how these contracts should be designed and some examples from around the world are given. As no two national railway systems are similar as well as no two National jurisdiction and regulatory environments are equal, there is a need for encompassing and adjustments in order to fit into another countries' contract. Hopefully, the further harmonisation of the European railways (internalisation of the European market) will reduce the National variations, and thus making contracting and regulatory environment more similar.

Transparency for all parties is a very crucial requirement for all infrastructure management activities. Based on transparency TOCs are able to develop, plan and improve own services without causing unnecessary path conflicts. Transparency helps to avoid path conflicts before they emerge. TOCs should be able to assess the economic impacts of certain decisions by route, time and choice of equipment.

Current practices in Europe vary significantly between European states. This leads to tremendous variations in infrastructure charges. Although most countries are using the SRMC principle, the practice of adding capital cost coverage factors to these charges leads to charges that are far from the true SRMC. In addition, the real SRMC might be very different between states and should therefore vary.

About allocation of tracks, the railway company owning rolling stock and infrastructure used to face problems in designing a timetable that met the objectives:

- Meeting the demands of passengers
- Meeting the demands of shippers and forwarders
- Necessary flexibility to cope with unexpected incidents
- Safety considerations
- Cost efficiency

It was seen that the infrastructure managers have an interesting position in the new railway reality: On the one side are the political aims and the limited funding from the public, on the other hand are the commercial markets. This environment is very demanding both for the IM and for the social planner.

Charging the use of infrastructure is a way to let the operators have the right incentives when choosing their activity level. All use of rolling stock induces tear and wear, not only on the rolling stock itself, but also on the infrastructure that is used.

Charging may also be seen as a way of gaining revenues to the IMs. However, we would not recommend this practice until a particular railway system becomes self-financing without public transfers. Otherwise, charges should be set in away that secure that all operators that are willing to pay the costs they induce on the network are granted access. In this way the European railways are kept able of adapting into a new era of increased quality and profitability.

Using this deliverable together with Improverail's state-of-the-art work on cost assessment performed in Work Package 5 and Work Package 6 may provide a useful tool in designing and assessing infrastructure charges. For slot allocation this deliverable should have given the reader an overview over potentials and pitfalls. The lack of a clear and undisputable slot allocation procedure that fits all countries is a result of the partners' common view: Such methodologies do not exist (yet). Possible ways to develop market oriented slot allocation is proposed, by introducing limited auctions for residual slots etc.

Work Package 7 in the IMPROVERAIL project recommends the following guidelines for infrastructure charging, slot allocation and harmonisation of charges:

- Implementation of comprehensive **railway management information systems** supported by harmonised costing principles, bringing clarity to railway charging across Europe. Data requirements in terms of costs related to network provision and associated benefits to the operation are most relevant. However other data elements should not be disregarded ,such as the ones related to the activity itself, e.g. actual capacity utilisation, slot availability, etc, which are very relevant in the scope of the relation between the IM's and the market (TOC's).
- Infrastructure charging principles based on **short run marginal pricing** (SRMC), although its non consideration of the need for capital cost coverage and of specific market aspects such as WTP may be understood as weaknesses of this approach, which may be compensated by a complementary charge. SRMC means that trains are charged per kilometre for the access to the railways. These charges should equal the costs of the train's activity borne by the infrastructure manager, the other operators as well as the rest of the society. Thus, external effects like accident costs and environmental costs are included. SRMC-pricing does not include investment costs. Therefore, the cost elements that are included are tear and wear (maintenance) of the infrastructure, scarcity cost of possession of track, congestion charging (delay costs), environmental costs as pollution and noise and accident costs.
- Cost elements may **vary both with type of rolling stock and for different parts of the railway network.**
- National valuations of these cost elements vary. **Variations in valuation** between countries are not regarded as a problem. Different charging principles in different states, is on the other hand a problem. This might lead to sub-optimal incentives of routing of trains etc. **Charges may vary but charging principles should not.**
- There is a real risk for too low activity and investment of all types if infrastructure charges related to recovery of investment costs are introduced. In this sense, SRMC ensures that the traffic that is excluded is not socially profitable.
- There are two motivations for departing from SRMC. One is **"second-best pricing"**, and is derived directly from economic theory: "If prices in one specific market are different from price equal to (social) marginal cost, it is optimal to adjust prices for alternative goods so that the relative price ratios are kept equal to those in the optimal situation. In practice: If road transport or aviation transport pay only 50% of their total social marginal cost, so should the railways, in order to avoid a bias in favour of road and aviation. It can be argued that political biases in favour of railways might lead to subsidies of railways hidden in "second-best" arguments. The obvious solution to this is to let all modes of transport pay for their social marginal costs, thus making second best optimum equal to first-best.
- Another argument is the need for a **capital cost coverage factor** from the operators for the funding of infrastructure. This argument may seems reasonable in terms of allocation, but leads to system inefficiency in utilisation. The optimal capital cost coverage factor is therefore zero. If some contributions are essential, a lump-sum transfer is recommendable. Charging a "per-kilometre" contribution margin leads to less railway activity than is optimal. Also competition might suffer if profitability of operators is affected. Politicians who see railways as a tool to increase the efficiency of the European transport system should note this.

- **Tear and wear** of infrastructure caused by rolling stock should be calculated at a desirable level of accuracy. This is a major element of SRMC. There will always be a great number of variables that affect these costs, and there will always be some inaccuracy and uncertainty in the calculations. The effort that is spent on these calculations are justified if the value of fine-tuning the methodology is equal or above the costs of estimation. Varying charges for different train-types if the underlying cost structure is different is recommendable. A top-down approach with a limited number of parameters seems sufficient in most cases
- System costs as **congestion costs and scarcity costs** are difficult to assess and to charge for. The best way to calculate these costs is in **well functioning auctioning systems**. Probably the worst way of measuring these costs is by a dysfunctional auctioning system. Therefore; recommendations for methodology for calculations of these costs can only be done for a given railway system, assessing the level of competition, the ability to control cooperation etc. and the level of these costs. Some networks do not have very much congestion, while others are severely congested. Complexity of calculation methodology should reflect the potential benefits of these calculations.
- In regimes where a well functioning auctioning system is unlikely, the congestion costs can be partly taken care of by either one or more **mark-ups for congested areas** in time and space, or **cost-benefit analysis** of different alternative timetabling solutions. The latter may be sufficient in very small networks only.
- **External effects** like environmental costs and accident costs should be based on calculations that secure that costs induced by different modes of transport in each country are treated in the same manner. Otherwise the relative prices of the different transport modes are altered. The methodology of assessing these costs is developed continuously. Regular revisions of charges based on new information on the valuation of these costs are probably necessary.
- The way that the national railway systems are organised affects the way that charges are set and collected. The **regulatory environment of the IM is greatly affecting the way that charges must be set** in order to secure the social optimum. Infrastructure charging is easier to implement in a regulatory environment where the IM does not need to be economically viable. An IM that can take the social optimum into account will be able to set the correct charges without much governmental control.
- When the IM is a self-financing entity running on commercial terms, the government must set the correct charges. Otherwise the IM will maximise its own profit or revenues instead of securing the optimal railway activity. Thus the need for **governmental control and surveillance** of the railway sector increases when the IM is separated from public control. Even the detailed calculations of maintenance costs need then to be revised in order to secure that the costs are not exaggerated.
- A profit-maximising IM is especially difficult to handle in a situation where the IM or one or more operators get **public transfers**. Then, the system must be controlled in detail in order to avoid monopolistic behaviour from the IM. Only when there is a certain level of production where the system as a whole is profitable without any public transfers, profit maximising IM seems reasonable.
- **Slot allocation procedures** mean everything from a round table designing the timetable to an advanced auctioning system for slots, bundles of slots etc. This deliverable explains opportunities that lies in auctioning procedures, but also describes many of the problems and pitfalls that such methodologies induce. A hasty introduction of such systems is therefore not recommended, because the efficiency of the timetabling procedures might be reduced instead of increasing.
- **Auctioning systems for residual slots** may be a first step towards an auctioning system for the majority of slots in the future.
- Such advanced system is likely to function only in situations with **mature competitive railway markets**. Such a market should have multiple operators that are able to deliver the same type of services. In addition public transfers to railway units should be clearly visible. For example public transfers to some bidders will destroy competition altogether. Such contestants should stand on equal

terms, so that the bids reflect their underlying and potential productivity and not their access to public money.

- Harmonization of charges should be secured by introducing the same charging methodology in all states. If costs are varying between states, charges should also vary between states. The charges of each line at all times of the day should be available for all parties upon request. Websites is a good alternative for letting international train operators gain immediate access in order to plan, register and price a specific train route. **Transparency** is thus a keyword in order to arrange for increased international traffic.
- Some **procedures for slot allocation** and infrastructure charging are presented. The procedures are meant as examples of how some problems can be taken care of within a relatively simple system, and not as ready-to-implement systems. The European railways are far too different and multi-faceted in terms of financial, political, economic and historical characteristics to expect that one charging procedure will function well everywhere.
- **Fair and non-discriminatory charging** is an absolute demand in order to develop competition in the railway operating market in the years to come
- There are good reasons for attempting to **harmonize national jurisdiction and regulatory environments**.
- Opening up for, and experiencing more **cross-border traffic**, passenger traffic as well as freight, will give us more information for what obstacles and problems are encountered in the different regulatory environments.
- The market will therefore **reveal costs and preferences**, so that in near future we will have more information for choosing among different regimes.
- There is a risk of **inefficient rerouting of trains** caused by different national charging practices. Only when the different charges are based on real internal and external costs in all countries, the market will act optimally.
- **The key word is not harmonisation alone, but transparency:** All prices must be visible, and the market and money-flows will give further knowledge for develop tomorrow's railway system. Through a more developed international railway market with transparent regulation, financial flows and charging principles, the way that charging principles should be harmonised will be more visible.
- There is a risk for **welfare redistributions** between countries, where countries near the hubs in central-Europe may pay for wear and tear of traffic that are to the benefits for countries positioned further out of the centre. This is an argument against lump-sum pricing and in favour of kilometre-dependent charging.
- Charging principles must be complex enough to include the most important train types etc, but simple enough to not make the business decisions for the operators **unnecessary complex.**
- New entrants may face troubles to provide a feasible and competitive set of slots. The risk that **existing operators use market power** to take the best slots in order to avoid competition is real.
- Slots sold to competing operators, should be sold in some way that reflects the **WTP** of the operators.
- PSOs and stability for end-users suggests that the **timetables must be set for a reasonable period of time** - at least one year.
- On the other hand, will too long timetabling periods reduce the **pace of reformation** in the railway sector.
- Slots can include **quality variables**, where WTP should reveal the market preferences and valuation
- **RailNet Europe** is a promising tool in order to provide help to international traffic. Such an organ might be vital in providing transparency

- Infrastructure charging and slot allocation procedures can be performed within all present **regulatory regimes.** The way that the IM is functioning, will strongly affect how the market will perform.
- Auctioning systems based on market mechanisms will not necessarily lead to better performance of the railway system. These methodologies demands both small and **transparent public transfers** to train and track as well as a real **competitive market for railway services**.
- The **preferred duration of the contracts** between infrastructure managers and train operating companies differs considerably between both sides. In order to make an investment in rolling stock worthwhile for a train operator, the operator will want to have a long contract in order to guarantee stability of fees; the infrastructure manager on the other hand will want to maximise flexibility by having contracts as short as possible. *Grandfathering* partly solves this problem, but will also act as a barrier against new operators entering the market.
- Slot allocation presumes a free market with competing parties. In the case of railways, the market might simply not be big enough for genuine competition, as in the case of scarcely populated countries. To reach the full economic and operational potential of slot allocation in these cases might be hard, if not impossible.
- Some IM's still have very cosy relationships with the national railway operators. This does not benefit the entrants, and will hamper the full development of competition. Non-discriminatory treatment for different operators is absolutely essential.
- An integrated international market for slots, freight or passenger, would certainly remove barriers for railway transport and make it a more competitive transport mode.
- Penalty systems could be applied, but determining how much damage is caused by a delay is very difficult; the time of the delay is a factor but also the number of trains affected by the delay. Finally it is not always clear who is responsible for delays.
- A well-functioning and flexible system must be offered to the various operators, rules that are imposed should be considered fair, operators must perceive to be using a good product. New systems are only accepted if they work well.
- Flexibility from the IM side in allocating alternative paths, allowing operators to meet sudden changes in demand; and flexibility with re-routing in case of sudden obstructions or other unexpected problems.
- Clear and up-to-date information from the IM side, providing the operators with transparent conditions, options and possibilities through high-quality Business-to-Business (B2B) information systems.

Some **pitfalls** that will erode the benefits from commercially oriented systems are:

- **Too high level of cost-coverage** of the provision of infrastructure. Most car users never pay for the road that they drive upon. Until then, neither should the railway passengers. The need for a certain level of cost recovery is understandable. It is in general better to tax the companies' income, rather than a kilometre-dependent charge. This element creates a spike between the optimal charge and the actual charge, and thus induces a too low level of railway service production. One argument against this viewpoint is that central states may
- Too much use of PSOs. PSOs should be used when railway services on some lines are socially profitable but not commercially profitable. Of course, if few lines are profitable, no market really exists, but as external conditions as technology, jurisdiction as well as the demand structure changes and evolves, new lines may become commercially viable. Then, the use of PSOs should be reduced. There is a risk that **PSOs may function as a pillow**, avoiding the stride to increase productivity.

- The authorities must ensure that international external conditions are set in such a way that international traffic faces the correct set of prices and as little bureaucracy as possible. **National protectionism** is a loss for all.

Regulatory environment

Public IMs might be less proactive in terms of market development. Public IMs might also be suffering from political control rather than aiming at efficient pricing. On the other hand, will the public IM design a charging system that is dedicated to maximise efficiency rather than profit. The demands for governmental surveillance and control should therefore be much lower, and thereby increase efficiency for the operators and low public expenditure on surveillance and control. Deregulating the IM may not lead to increased efficiency in the market; increased governmental control must follow such decisions.

The socio-economic success of those systems depends on the efficiency of regulation and on the degree of competition between TOCs. Presumably this degree of competition will be sufficient mainly for relations in and between urbanised regions. Regulation of the IM has not only to ensure the discrimination-free access to path capacity at earlier stages of implementation but also the right incentives to the IM to realise static, qualitative and dynamic (investment) efficiency.

In order to meet the demands stated in this section, two new international organs may be necessary. First, a unit that can perform surveillance over the charges set in all European countries should be able to reveal discriminatory behaviour or profit-seeking behaviour among infrastructure managers. This **surveillance organ** should be continuously active; in order to avoid that discriminatory or other harmful behaviour can persist.

This organ should also keep an eye on timetabling procedures and other track allocation procedures, to ensure that these are performed within the ruling regulatory framework.

Another organ may also be implemented: An **Information organ** keeping track of all charging procedures, track allocation procedures etc as well as the operators' data needed for assessing charges and be granted access to a specific piece of track.

International traffic and SRMC

Charges may for different reasons vary from SRMC. In such cases, the non-discrimination of railway operators must still be secured. In an international environment also the non-discrimination of IMs must be secured. If one IM charges above SRMC, the other IMs will suffer a relative disadvantage. On a specific route, an operator may be able to pay high transfers to one IM if the rest of the route is run on tracks where only SRMC is charged. In a system where all operators would charged the same contribution marginabove SRMC, this relative disadvantage would disappear. There is a need for international surveillance of the IMs, to secure that market power is not abused.

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Appendix 1: Case study: Great Britain, Railtrack

This appendix includes a thorough analysis of British railtrack. This analysis has been undertaken within WP7.

A1.1 Case study: Railtrack / NetworkRail

A1.1.1 Privatising the Railways

After 1979 the conservative Government of Great Britain under Mrs. Thatcher launched a programme to privatise most of Britain's national Industries. This included the sell of British Telecom (BT) in 1984, gas supply in 1986 and water supply in 1989. All were sold as monopolies. Shortly afterwards "some ministers and officials became increasingly concerned about the variable standards of efficiency and service quality of the privatised companies, especially where they continued to trade as monopolies". [FREEMANN 2000] It became recognized by politicians that performance was more an issue of competition than of property rights. As consequence the electricity industry was privatised vertically separated into the divisions:

- Generation: initially 2 companies, 14 licenses by 1993
- Grid: regarded as natural monopoly, kept as one unit
- Supply: regional companies.

The route towards rail privatisation

Prime minister Thatcher hesitated with rail privatisation and is said to have seen it as "the Waterloo of this government". Nevertheless the Treasury and several Transport Secretaries pushed for tackling the issue. In 1988 the Department of Transport (DoT) came up with five models for rail privatisation:

Table 16: Department of Transport's view of benefits and problems with privatisation (1988)

Model	Advantages	Disadvantages
Regional		
Splitting of BR services into around 12 regional companies	Some competition but largely indirect; improved morale through local loyalty; improved flexibility and efficiency	Problems with through trains between regions; possible loss of economies of scale; business "mix" within each region requires division of management attention
Track authority		
vertical separation	Promotes competition	On-rail competition limited by railway practicalities, e.g. economics, capacity; track authority still a monopoly and difficult to regulate; track authority remote from rail users; investment decisions difficult; potentially high transaction costs
BR plc		
BR privatised as monopoly	Continuity of style and structure; minimal cost of privatisation	Not even limited competition; size of BR has engendered "diseconomies of complexity"; lack of operational transparency
Horizontal separation		
Splitting of BR into regional, inter city and freight companies	Avoids problem of operational transparency	Difficulties with track ownership
Hybrid		
	Better features of other models can be incorporated while their drawbacks can be avoided	

The Treasury preferred the track authority model to promote competition. The intention was "to strip [the monopoly] down to the natural monopoly". The idea was to run train services in open access with on-route competition between train operators.

By the time several problems were recognized with track authority model:

- timetable planning

- delay handling

- through ticketing

- no turn up and go [because the rider has to buy a ticket for a specific TOC].

Structure of the privatised rail

Also a hybrid model was recommended by a working group in 1991 the track authority model was actually adopted for privatisation. The decision was influenced by the great urgency the process became after the 1992 election. The White Paper "New Opportunities for the Railways" set out - without much detail - the structure of the privatised railway which is reproduced in figure1. As John Swift, the first Regulator, describes: *"There was minimal details beyond this in almost all areas of rail policy and regulation was no exception."* [SWIFT 2001].

The Railways Act of 5 November 1993 still left many things undefined. According to SHAW, "no details were provided for: the structure of the industry, the framework within on-rail competition could develop or how rail companies could be regulated." [SHAW 2000, p.26]. Theoretically it leaves much power for the Secretary of State, who can take final decisions on most regulatory issues.

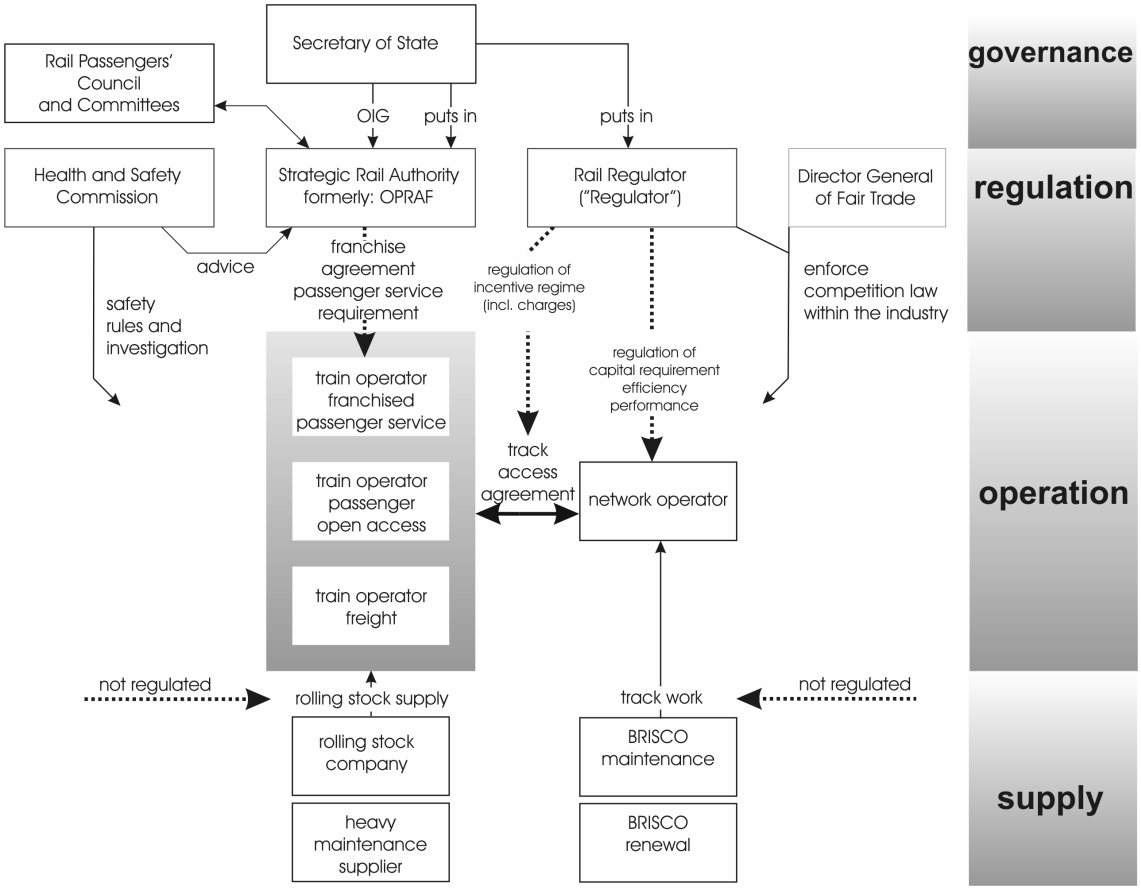
Not all relationships in the industry are regulated. The contracts between providers of rolling stock and the TOCs and between the (track) maintenance suppliers and Railtrack are solely subject to their negotiation. Regulation between open access passenger operations and freight operations on the one hand and Railtrack on the other is limited in comparison to the regulation of franchised passenger services.

Regulator 1997 (on establishment of the SRA)

"However, there are two particular areas where I believe the Regulator's powers are not adequate. These are constraints on the Regulator's powers to protect passengers and the exclusion from the definition of "railway services" of the activities of the Rolling Stock Companies (ROSCOs)."

BR Freight consisted of four divisions. The only profitable was the trainload service which carries mainly coal and steel. The others were Freightliner (container services), Rail Freight Distribution (what was left of wagonload services) and Royal Mail Services. Once again the trainload service was divided into three companies on a geographical basis to promote competition. Due to a shortness of bidders five of the then six divisions were sold to a single buyer which was later renamed English, Welsh and Scottish Railway (EWS). Freightliner became the second Freight Railway. In 2002 GB Railfreight, a special carrier for nuclear cargo, entered into the market for container hinterland transport out of the harbour of Felixstowe.

Figure 11: Structure of the privatised rail



A1.1.2 Development of Rail Regulation

The British Privatisation Model leads to dual regulation. The regulatory bodies are partly buyers of train services and partly responsible for the price of train services (through the determination of track access charges). Both tasks cannot possibly lie in one hand. Rather should there be on the one hand a regulator for the industry (to ensure especially that the infrastructure monopoly raises fair prices) that is independent from government. On the other hand should there be a controller for the huge amount of public money that is transferred to the industry as subsidies. The first regulatory body became the (Office of the) Rail Regulator (ORR) whose key function is the regulation of Railtrack and the train operating companies. The later instance became the Office of Passenger Rail Franchising (OPRAF) whose key function was to ensure that the customers of passenger rail get value for money (subsidy and fares). When doing so OPRAF – and later SRA had to respect a set of OIG (Objectives, Instructions and Guidance) drawn up by the Secretary of State for Transport.

The following table shows further responsibilities for specific issues that are not always clearly separated. [WOLMAR 2001]

Table 17: Distribution of responsibilities between ORR and OPRAF

	ORR	OPRAF
Fares regulation		X
National railway timetable	X	
Disabled access	X	
Telephone enquiry bureau	X	(X)
Impartial retailing	X	(X)
Routeing guide	X	(X)
Through ticketing	(X)	X
Multi-modal ticketing		X
Discount cards	(X)	X
Interavailability		X
Information at stations	X	X
Timetable connections		X
Passenger's charter		X
Complaints handling	X	(X)

(Parantheses around Xs indicate secondary responsibility)

With the establishment of the SRA the interaction between the two regulatory bodies broadened as the SRA became practically buyer of infrastructure services which the network operator provides under ORR-regulation.

The third pillar of rail regulation is the Health and Safety Executive who develops safety rules for the industry and carries out investigations into accidents.

Regulation by the Rail Regulator

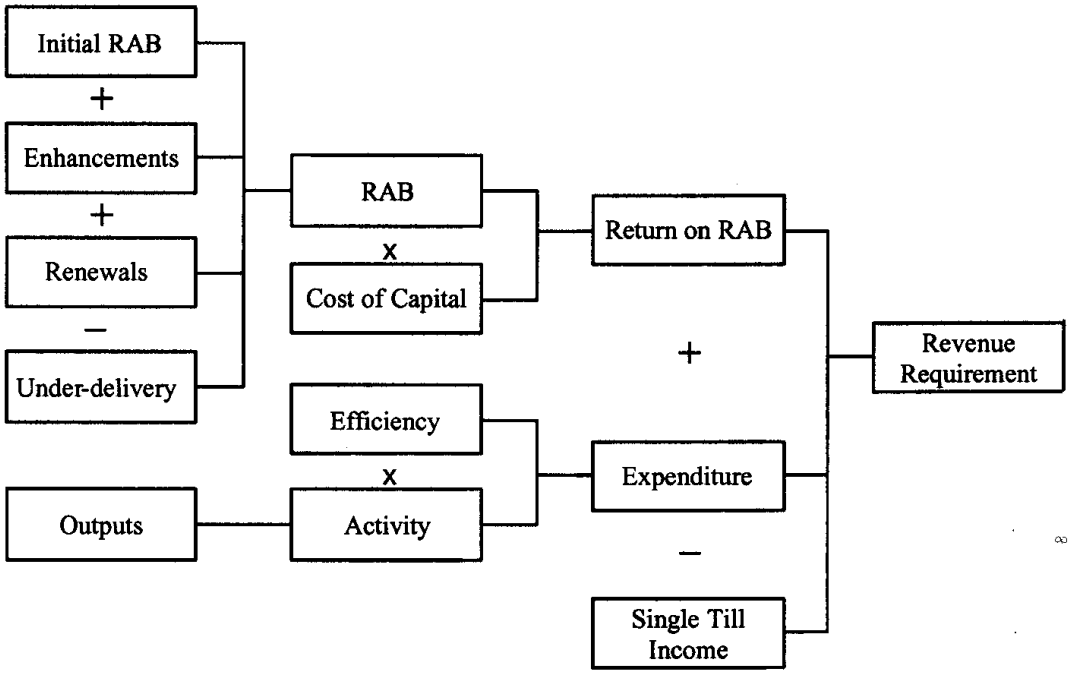
The Regulator is not only independent from governmental order but also from OPRAF because OPRAF has a contractual relationship with the franchised train operators and is buyer of these train services.

When the question arose who may provide strategic leadership to the industry Winsor resumed the Regulator's task [ORR 99]: "Regulation must continue to focus on remedying market failure and controlling abuse – wherever it is found – to secure fair treatment of dependent users, operators, passengers or freight users."

The whole regulatory regime is reviewed each 5 years, forming one control period with the first starting in 1996, through the "Periodic review of Railtrack's access charges". The many malfunctions of the system proved it necessary that intermediate review are undertaken to make adjustments to charges or contractual regimes.

Railtrack's income is regulated trough the rate-of-return on a regulatory asset base and the expected efficiency savings for the following control period. Figure 2 shows the way Railtrack's revenue requirement is set.

Figure 12: Calculation of revenue requirement [ORR 2001]



Expenditure and overall level of charges

The first review of Railtrack's original access charges made the following assumptions on revenue expenditure (in 94/95 £):

maintenance and operations	£ 1.47 bn pa, increasing with inflation minus 2% pa
asset renewals	£ 0.57 bn pa
investment backlog	£ 0.50 bn for the control period

The investment backlog was not to be covered by access charges but to be added to the asset value at the end of the period. Therefore Railtrack started of with an annual expenditure projection of £ 2.04 bn. An report from Booz Allen & Hamilton (BAH) points out that the allowance for asset renewal was recognized as insufficient. The Long Form Report projected expenditure on renewals of 0.88 bn pa during the first control period. And in May 1996 in the prospectus for Railtrack's flotation the Regulator expected Railtrack to invest £ 3.5 bn in the renewal of the network during the period. [BAH 1999]

Railtrack's revenue requirement has to be completely covered by track access charges. Public grants are expressed as parts of the fixed charge that is charged to the funders. A Charging Implementation Group developed the original charging system in 1994 prior to Railtrack's vesting. They should have covered operating costs, depreciation and return on capital, based on the Modern Equivalent Asset Value and a rate of return of 5,1 %.

In 1995, prior to flotation, Regulator John Swift reduced charges by 8% for the period 1995/96 and allowed increases of inflation minus 2% in subsequent years. But in the same year, Swift allowed Railtrack to charge an extra 75m for possible losses from the performance regime, which meant that about 3% of the 8%-cut were recovered.

Actually, Railtrack's maintenance, renewal and operating expenditure was steadily increasing during the first control period (95/96 – 00/01), from about 2,2 bn in 95/96 to nearly 3 bn. The regulator's projection for the second control period shows an expenditure of 16,15 bn for the five years (operational expenditure of 4,519 bn, renewals of 8,268 bn and maintenance of 3,346 bn), which makes about 3,2 bn annually. Considering the savings through improved efficiency leaves an expenditure of 14,87 bn equalling about 3 bn annually. Consequently the level of charges was increased by about 50% for the second control period.

Regulatory Asset Base

The regulatory asset base was set at 5.515 billion for the beginning of the control period 2001-2006. This amount contains (in 98/99 prices):

initial value	£ 3.040 bn
backlog *)	£ 0.530 bn
renwals	£ 0.700 bn
enhancements	£ 1.365 bn
under-delivery	£-0.120 bn

*) An investment backlog which Railtrack inherited from pre-floatation time.

Capital cost

The cost of capital is currently was increased with the review from 5,1% to 8%, admitting a higher risk in Railtrack's operation of the network.

Efficiency

Railtrack's efficiency target by which the value of expenditure is decreased shall be set "so that:

- the resulting cost levels are achievable [..];
- Railtrack gets incentives to outperform the assumed efficiency savings by being allowed to retain the benefits for a period of years; and
- it is not unduly difficult for Railtrack to finance its relevant activities."

For the second control period the regulator set a target that is equivalent to annual savings of 3.1% over the 5 years.

The regulator relied on comparison with international best practice and on comparison with efficiency savings gained by the National Grid Company after privatisation. Adding a potential for changes in Railtrack's contracting strategy the Regulator assumed efficiency savings in the five years of the second control period of 2, 3, 4, 4, and 5% respectively. This gives a constant equivalent of 3.1% calculated from the 2000/01 base.

A difficulty of assessing Railtrack's efficiency is to distinguish whether Railtrack is inefficient due to bad management or due to the state of the network Railtrack inherited. E.g. the British network used to be underfed with ballast but Railtrack should bring bedding to a modern level. So even if Railtrack performs well, there will be routes with poor ballast left of BR at times that cause higher than normal usage costs.

BAH used a number of indicators to evaluate Railtrack's efficiency, e.g. the number of sleepers or rail-km replaced or the average age of rails. Comparisons to US values were undertaken but whether the US rail-network is comparable to UK's is questionable (the US network is a low-speed heavy freight network).

The **incentive framework** between Railtrack and the TOCs is basically set out in schedules to the track access agreement.

Schedule 4 possession regime

Schedule 5 train path quality

Schedule 7 charges

Schedule 8 performance regime

Possessions (schedule 4)

A possession is an allocated train path of which the network operator takes possession for track work. Schedule 4 provides a compensation regime for possessions and, in particular, incentives for the early planning of possessions.

The payment rate is based in the rates under the performance regime with discounts for early notification. These discounts are

- notification at least 46 days in advance → 75%
- notification at least 22 days in advance → 50%
- notification until 22h the day before → 20%

Railtrack's estimated costs under the possessions regime for the second control period are 370 million in 98/99 prices.

Journey and departure times (schedule 5)

To allow Railtrack a certain amount of flexibility in timetable planning and operation, it may flex the regular travel time a service normally takes to run on a line from point A to B. This means that some trains may be scheduled with longer travel times or differing departure times. Originally minimum / maximum travel times per route section where incorporated into schedule 5. This was to assure that Railtrack maintains the network in a way that travel times do not deteriorate over time.

With the second review of track access charges a new schedule 5 was introduced, that rules the topic more precisely. The regulators approach was, that TOCs may be more interested in the travel time the majority of their trains can offer and less in the journey time of the slowest trains. He also feared, that when agreeing solely on a maximum journey time Railtrack may tend to schedule all trains at the maximum to relief pressure under the performance regime.

Thus the new form of agreement between TOCs and Railtrack contains regular and maximum journey time and the percentage of trains that runs within the regular time.

Track access charges (schedule 7)

As stated above the access charges have to cover Railtrack's revenue requirement. There are variable parts (usage, electricity, scarcity) that are independently assessed, the remainder is charged over a fixed charge ("fixed" meaning that the aggregated amount is pre-set, not meaning that it is a lump sum to be paid by every operator).

Originally the variable part of the charge was set low, accounting for about 9% of the charge's volume. The fixed charge made the bulk of the charge, representing 91% of Railtrack's required income. This charge is allocated to the operators according to their share of train-miles. The result was an insensitivity of the system to changing traffic volume. New trains brought Railtrack very little extra money. As Leathley says: "Passenger-train operators are in fact able to increase the amount of trains they run by around 8 per cent without paying additional track-access charges [..]." [LEATHLEY 2000]

Congestion costs of new services were taken into account by a negotiated congestion fee. In the same way a negotiated profit share set Railtrack's incentive for increasing capacity. Unfortunately both incentives turned out to be insufficient. Since Railtrack did not earn from additional trains it had no interest in providing capacity. Worse, if in fact more than 9% of Railtrack's costs were variable with usage – what experience elsewhere suggested – Railtrack would loose from additional trains. Although Railtrack could achieve some improvements in the first two years it performed badly in capacity enhancement during the first control period. The operators introduced new services anyway because of their low marginal costs. The result was a deteriorating network performance.

Both Railtrack and the Regulator worked on a revised charging system for introduction with the review of 2001. The main topic was to sharp the incentive for more capacity. The points were:

- introduction of a capacity charge
- introduction of a fixed profit share (volume incentive)
- a tightened performance regime

The components of the charging system now are

- usage charge
- capacity charge
- electricity charge
- fixed charge
- volume incentive

Excluding the volume incentive, the income from charges was set for the second control period at:

(01/02 £)		
usage	871 m	8,9%
capacity	392 m	4,0%
electricity	699 m	7,2%
fixed	7776 m	79,9%
total	9738 m.	

The overall variability of charges increased to 20% compared to 9% in the first control period.

Usage, capacity and electricity charges charge for marginal costs. Of the three, the electricity charge has caused the fewest disputes so far though it includes a charge for electrification asset usage, which has to be analysed like all usage costs. The other two are discussed in more detail in the next sections.

Analysis of usage costs

Usage costs are the costs that are directly incurred by a train on tracks and structures (but not on electrification infrastructure). Their calculation is based on a model called MINI-MARPAS used by British Rail, which calculates usage cost estimates for all different vehicle types. As BAH writes in 1999: "It was intended at the time these charges were developed that, in the longer term, Railtrack would refine its approach to estimating these costs which varied with usage." [BAH 1999]

While BAH analysed usage costs for the Regulator analysis for Railtrack came from AEA Technology that had bought BR Research. For track usage Railtrack/AEA came up with a "bottom-up" approach. Based on the MINI-MARPAS a set of track damage models was developed which calculate maintenance requirement per vehicle km for different vehicle types and track categories. Combined with the unit costs of maintenance activities costs per vehicle km can be calculated. "The damage models use [..] detailed data on vehicle characteristics, particularly speed, number of axles, unsprung mass, and suspension characteristics." [BAH 1999] The main criticism on the models was that it charges the TOCs the costs of what should be done for maintaining the network because it calculated maintenance costs ex-ante. But it was in no way assured that these activities were actually carried out.

BAH instead recommended a top-down approach which uses Railtrack's actual maintenance activity as cost base. Maintenance work has to be classified in different categories (see below) and cost variability with usage was analysed and estimated in several engineering studies for setting variable charges at an appropriate level. Not surprisingly some dispute arose between Railtrack and the Regulator over these variability estimates with Railtrack naturally seeking for a higher-level variability. In a second step cost drivers for the variable costs were identified.

The different asset categories in the analysis of usage cost were:

- track
    - rails
    - sleepers
    - ballast
    - switches and crossings
    - inspection
- signals
    - multi-aspect light
    - shunt signal
    - electric and hydraulic points
    - mechanical points

- level crossings

- electrification
  - DC
    - conductor rail
    - substation
    - HV feeder cable network
  - AC
    - contact wire
    - other OLE equipment
    - feeder station equipment
    - line side structures

- structures

The analysis of variability of costs with usage goes far into technical details and if available an abundance of data can be used in the issue. A problem of the top-down approach is, that cost variability is not equal for all routes but varies with the cost drivers itself. As an example table 15 shows the variance of cost variability with daily tonnage on a track.

Another interesting finding of the analysis in UK is that cost variability differs with track quality. The harm of e.g. bad suspension is lower on modern, well-maintained track – reducing the suspensions impact on cost variability – than on ill-conditioned track.

Table 18: BAH's conclusion on cost variability

Asset category	percentage of costs variable
Track	**38**
- Maintenance	30
- Rail Renewal	95
- Sleeper Renewal	25
- Ballast Renewal	30
- S&C Renewal	80
Structures	**10**
Signals	**2**
- Maintenance	5
- Renewal	0
Electrification	**24**
- Maintenance	10
- Renewal DC	41
- Renewal AC	35

Still, cost variability does not give information on which the drivers of cost variation are. For identifying cost drivers BAH analysed maintenance expenditure for different network sections and compared this with the characteristics of traffic running over the section.

Their regression showed, that most cost variation can be explained by three variables of traffic

- axle load
- speed
- unsprung mass

further are some specialities covered by extra coefficients

- coal wagons because they pollute the ballast thus reducing its yielding and draining capability
- multiple-unit vehicles and passenger coaches for their lower traction effort
- a specific multiple unit (class 14x: "Pacer") for having a less track friendly suspension

With the above characteristics every vehicle can be assigned a damage-equivalence factor (DEF) of the type

$$DEF = axleload^{0.49} * speed^{0.64} * unsprung\ mass^{0.19} * dirt * mu * pacer$$

with dirt = 1.2 for loaded coal wagons (else 1), mu = 0.89 for multiple units (else 1) and pacer = 1.1 for MUs of pacer class (else 1).

The resulting level of variable charges found by BAH are given in table 3.

Table 19: BAH; variable charges

		charge until 2001	BAH base
average passenger charge	p / veh-mile	5,65	11,83
average freight charge	p / veh-mile	7,07	10,62
average passenger charge	£ / 1000 gt miles	1,30	2,85
average freight charge	£ / 1000 gt miles	1,43	2,44

It is obvious from this study that the marginal costs of a train run are roughly twice as high as was assumed hitherto. Nevertheless the share of the usage charge stayed at 9% of the charging volume. The recommended increase in the variability of charges was achieved by the introduction of the capacity charge.

Congestion costs and Capacity charge

Railtrack claimed that an increase in number of trains of 1% leads to a 2,5% increase in congestion-related delays. Between 1995 and 1999 the number of trains increased by 8%. The existing negotiation of a congestion fee for new services until 2002 was neither really liked by the TOCs nor by Railtrack because it caused transaction costs and uncertainty in the financial planning. Thus all parties agreed on introducing a pre-set congestion charge, called capacity charge.

A consultation document set out four possible dimensions of the capacity charge

- route section
- time
- service speed
- schedule 5 flex

The regulator concluded that the charge should be differentiated to rote section and time. Service speed shall only for new services be used as an indicator. Railtrack expects that occasions where new services have a considerably different speed than existing services will be rare, so that a negotiated fee can be retained for these cases. Railtrack's flexing rights are not incorporated so far.

The unit prices for the capacity charge were developed by comparing empirical data on train frequency (degree of capacity utilisation) and delays. Railtrack recovers half of its performance payments by the congestion charge, the other half remains being covered over the fixed charge.

Allocation of the fixed charge

The basic principal of allocating the fixed charge between the operators and the funders (mainly Passenger Transport Executives and the SRA) is to sum up Railtrack's costs in specific categories and to break them down again onto the relevant operators or funders. The metric for allocation of the charge to the operators (Step 5) is their number of vehicle miles actually operated.

- **Step 1 –** determine allocation treatment of each single till item;
- **Step 2 –** allocate cost and revenue items between the individual categories (national, specific zones or strategic routes) in accordance with step 1;
- **Step 3 –** cost and revenue items allocated to individual categories will then be summed;
- **Step 4 –** the totals for each category will then be allocated between TOCs and funders
- **Step 5** – each of the cost categories (national, Strategic Route and zonal) will be summed for each TOC and funders;
- **Step 6** – any TOC specific revenues will then be added to the resulting charge;
- **Step 7** – the resulting charges will then be profiled to be consistent with the Regulator's determination;
- **Step 8** – charges for enhancements negotiated in the first control period will then be added to the individual fixed charges; and
- **Step 9** – the resulting base fixed charges will be scaled down to take account of the central revenue grant and profiling of the revenue requirement

The allocation of Railtrack's costs to a cost category may not always be clear, the regulator states the necessity to "identify the most granular level of data available and use it to construct a disaggregation metric." [ORR 2001].

Main data sources for the process are

- the outputs from a process of zonal cost analysis which Railtrack carried out specifically for this purpose, in March and April 2000;
- detailed breakdowns of projected future expenditures as laid out in the 2000 Network Management Statement (NMS); and
- Railtrack zonal business plan data.

Performance regime (schedule 8)

A performance regime was negotiated between BR, Railtrack, OPRAF and the regulator under supervision of DoT and was introduced on 10 December 1995. Edmonds explains:

"In simple terms, the scheme established by service-group average-delay benchmarks achieved for the 3 years prior to privatisation. Performance was reviewed each 28 days [..] and where Railtrack achieved an average below the benchmark then the TOC would pay Railtrack, at a rate agreed for the service group, and when Railtrack failed to achieve its benchmark then it would be penalised with payment to the TOC.". [EDMONDS 2000]

BAH found the system to operate soundly, however some criticism arose. Charles Belcher, Managing Director of Silverlink, found fault in the level of payments: "*the level of incentive and penalty available to Railtrack is really not large enough to influence a multi-billion-pound-turnover company.* Others criticized the effort train operators needed or wanted to take to assure delay responsibility was fairly allocated.

The first two years after implementation saw significant performance improvements, but in the third year Railtrack only achieved a 2% improvement. Railtrack agreed to a 7,5% improvement in 98/99 but failed to deliver. In August 1999 the Regulator Tom Winsor placed an enforcement order on Railtrack to deliver an performance improvement of 12,7% in 99/00 (to catch up the missing performance improvement from 98/99) with a fine of 4 million for each percentage point of under-delivery. Railtrack nearly managed to achieve this target, before the Hatfield incident made the whole system temporarily absurd.

Regulation of Railtrack's freight services

As with passenger services the Regulators key function for freight is to approve the track access agreements between Railtrack and the FOCs which include the charges.

After the six freight companies where established in shadow form within BR the original access contracts where negotiated with Railtrack. For the trainload companies the contracts where set per route, which lead to about 150 different contracts. In contrast there was one national contract for Freightliner. The government had set a principle that the charges should reflect the market value of the freight traffic. The sell of the freight railways ended in the dominance of one operator, EWS. EWS soon sought to replace its numerous contracts by a single contract. The result was a single 4-year-agreement with high fixed charges but at a competitive low level. The then Rail Regulator John Swift intervened and limited the number of paths for EWS at bottlenecks because he feared that the passenger operations could be adversely effected by the contract.

Structure of track access charges for freight

Though set and reviewed separately, the structure of track access charges for freight are today generally in line with those for passenger services. The major difference between freight and passenger charges is that freight services do not pay for Railtrack's fixed costs that are common between passenger and freight traffic. The freight's fixed charge is taken over by the SRA through an adjustment of the network grants which Railtrack receives from SRA.

The review process in 2001 showed a general tendency that determined charges are preferred amongst the rail freight industry, as pioneered by EWS. So the new freight access charging system looks like this:

- Variable charges include usage, traction electricity, a performance components and a capacity (congestion) charge.
- The same top down models, including track damage models that are also used for passenger charges, calculates the usage charge. The charge is differentiated

for wagon and loco type and a discount for wagons with track-friendly suspension was introduced with the review of track access charges in 2001.

- Capacity charges for freight are currently set at a rate 10% lower than for passenger services, taking into account that freight trains can normally be scheduled with greater flexibility and therefore impose a lower risk for congestion costs under the performance regime than passenger trains. For the same reason Royal Mail services pay the full capacity charge.

Charges are still agreed upon individually between Railtrack and each freight company, but the Regulator expects all network access agreement s to include the above aspects and to result in a comparable level of charge for each operator.

Allocation of train paths

The system of capacity allocation is governed by the structure of the privatised rail. Most passenger trains run under a franchise agreement which sets out the nature of the service, route, service hours, minimum frequency and minimum journey times. These characteristics are incorporated into the track access agreements and in its timetable planning Railtrack has to respect the operator's duties under the franchise agreement as well. Furthermore, to avoid coordination failure, Railtrack and the operators are bound by contract to provide connections between their services. As a result, the degree of freedom in the planning process is limited. The regulator overviews the timetabling process with his regulatory objectives and intervenes casually, like in the said EWS access contract.

The regulator of 1997 describes the timetabling process as an "essentially consultative one which includes

- the production by Railtrack of initial timetable parameters, including details of engineering work proposed;
- an iterative bidding process during which train operators bid for train paths consistent with their access rights and Railtrack allocates capacity on the basis of public interest decision criteria;
- an appeals process to settle disputes; and
- the production, and ultimately publication, of the timetable by Railtrack." [SWIFT 1997b]

The public decision criteria are focused on passengers and describe the benefits the resulting timetable shall have, but do not include rules to solve a specific path conflict:. This is even more insufficient since Railway Act requires the Regulator to protect "the interests of persons providing services for the carriage of passengers **or goods**" and the growth of rail freight transport is heavily emphasized by the government.

In 2001 it was publicly recognized that the determination of capacity rights is a shortfall of the system. The likely impacts on allocation efficiency became even greater as the degree of network utilisation increased. Therefore the Secretary of State has directed the SRA to develop a policy for the utilisation of network capacity.

SRA started the consultation process in 2002 and implementation of the policy is planned for 2003/2004. The approach is a combination of coordinated timetable planning, investment management and path restriction. The SRA is going to regulate – where necessary – the number of paths that have to be reserved for long-distance trains. Under a National Network Utilisation Strategy the SRA will develop Route Utilisation Strategies which include core service frequencies, principals by which conflicts are to be addressed and implications for investments. Other measures are the production of forward timetables

(draft timetables for more than one year in the future) that help to assess investment and rolling stock requirements in new franchise agreements that guarantee short running or dwell times. [SRA 2002]

Stewardship of the network

John Edmonds questions the widely shared opinion that Railtrack underspent on the network from the start. [EDMONDS 2000] He points out that Railtrack faced budget constraints while it was still a public company and was "unable to spend against the full Asset Maintenance Plan change in its accounts. The outstanding figure was carried forward as an accrual in its balance [..]." As a consequence Railtrack was floated with an investment backlog of about £700 million. This backlog was never removed although Railtrack actually spent more in the first control period than the Regulator had foreseen as expenditure requirement.

Nevertheless Railtrack could not clear the concern of insufficient maintenance and renewal activity (underinvestment) in the years following. Moreover the regulatory framework left the regulator with no power to make provisions for specific improvements. In brief, Railtrack did not have to enhance the network if it preferred not to do it. Railtrack's Network Management Statements which it was obliged to publish gained wide criticism for a lack of strategy as well as detail and verifiability.

New license condition 7

After a review of Railtrack's Network Management Statement for 1997 the Regulator John Swift replaced the existing Condition 7 of the Network Licence by an entirely new one. The intention was to improve Railtrack's accountability for its activities in maintaining, renewing, enhancing and developing the network. The old condition had simply imposed on Railtrack an "obligation to plan" but not to deliver. The new condition introduced not only a stronger duty to relate planned projects to the users need (para 5) but also a duty to report the progress of work against the previous network management statement (para 8). This gives the regulator a basis for enforcement action if Railtrack fails to achieve its own targets. However the regulator's power is limited. As Swift explains: "I have a duty under section 4 of the Railways Act [..] to act in a manner which will not render it unduly difficult for Railtrack to finance its regulated activities. I cannot, therefore, impose an absolute obligation on Railtrack which takes no regard of its ability to finance its activities." [FREEMAN 2000, p. 79]

The BAH report of 1999 attests that "Railtrack's physical activity in renewing assets has been below expectations." [BAH 1999].

In 2000 a new paragraph 16A-16I was incorporated in the Railway Act that allows the newly established Strategic Rail Authority (SRA) to direct Railtrack to carry out specified improvements on the network.

A critical point that was identified with Railtrack's dissatisfying performance was Railtrack's lack of knowledge over the condition of its assets. The need for an extensive database that contains information about age, state-of-repair, contractors became even more vital as contractors, which Railtrack did not adequately monitor, carried out the work on the network. Databases existed but were run by the contractors individually. The implementation of a single asset database (IAMS) should have been completed in 2001.

Regulation by OPRAF / SRA

Key of the passenger service regulation is the passenger service requirement (PSR). It determines for each route a minimum service frequency, maximum journey times, the time of the earliest and latest trains and, in certain cases, minimum capacity levels. The level of service was by and large based on the foregoing BR service.

OPRAF also safeguarded service at stations. In the franchise agreement the required service from both hours to public phones on platforms was defined. OPRAF monitored the compliance and penalised an operator for failing – which became published in annual reports.

The strategic development of the rail network became a most critical issue in the time after privatisation. Railtrack took over the operation of the network in 1994 and most passenger rail franchises were let in 95/96. In the year privatisation was completed, 1997, the Rail Regulator introduced the described new licence condition 7 to strengthen Railtrack's obligation to deliver network enhancements. But the new government "was looking for much greater institutional changes to reassert control and direction over what was perceived to be a disaggregated and leaderless railway." [SWIFT 2000] Thus was proposed the establishment of a Strategic Rail Authority as a response to Railtrack's failure to provide a strategy for and to conduct investment into the network and of the dissatisfying quality for passengers in the daily services.

The SRA was created in shadow form in 1999 and legally established with the Transport Act 2000. Like OPRAF it operates under Directions and Guidance from the Secretary of State for Transport.

Superordinated aims were:

- to increase public accountability of the railway
- to provide strategic leadership for the industry

The first point resulted in the SRA's absorbing the functions of the Franchise Director, including the overseeing of franchises and the existing powers to protect consumers.

The second point has much broader implications. The SRA translates the governments transport policy into actions for the railway. As the then Regulator, John Swift, suggested, the SRA should not command the passenger rail, it should be the agent of the government. It should decide what kind of passenger and freight railway should be publicly sponsored. Logically, the SRA takes decisions about network enhancements and finances them. So not only is the SRA buyer of train services (like OPRAF before) but it is buyer of infrastructure also.

One of the early actions the SRA took to provide network improvements was the Incremental Output Statement scheme (IOS). The SRA discussed possible IOS's with the operators and Passenger Transport Executives. 335 schemes (either improving capacity, journey time or operational flexibility) where presented to Railtrack and the Regulator analysed the resulting revenue requirement for the network operator who where to deliver the IOS. After considering the prices and times of possible completion of the individual schemes the SRA kept 211 measures to be incorporated into the following periodic review. For the relevant operators the fixed charge will be increased by a predetermined amount as soon as an IOS is completed.

Investment into the network was Railtrack's task. After Railtrack's collapse a major policy change took effect in that "infrastructure investment and refranchising are likely to proceed along separate, but closely-related courses." Already in its IOS-proposal of 1999 the SRA had suggested that schemes that can't be directly brought forward with Railtrack could be implemented in connection with a franchise replacement.

The SRA was also prepared to agree to long franchise terms up to 20 years like for the Chiltern and South Central franchises were the SRA hoped to secure in return 370 m or 1,5 bn of investment capital from the operators [RG 9/2001]. Obviously the operators are much more willing to contribute to capital projects if they are dedicated to "their" routes.

The Secretary of State, Stephen Byers, followed a more short-term focus. On 16 July 2001 he announced that he wanted the SRA "to concentrate on improving services for passengers within existing franchises, or by negotiating short two-year extensions." [RG 9/2001]

The policy requires more financial commitment from the franchised TOCs but also strengthens their role because they now participate in capital decisions through the franchise negotiations.

In 2001 the SRA came up with a strategy that included reducing the number of operators on major lines. Essentially there should be only one franchised operator at each of the London terminal stations – at least as far as feasible. The motive is that the SRA values the gains through better service optimisation higher than the loss of competition. The SRA states:

The proposed policy

The SRA proposes to pursue the objective of having a single (substantive) operator at each of the major London termini. We believe this approach is right for the following reasons:

- *A single operator would facilitate optimum use of available capacity both in the station and on the approaches to the station.*
- *A single operator would provide a simplified, more understandable and impartial day to day interface with the passenger*
- *A single operator would remove many contractual interfaces at stations and simplify the timetable planning process.*
- *A single operator would improve reaction to service disruptions.*
- *A single operator should be able to exploit improved economies of scale.*

There are some potential disadvantages from this approach, which we recognise. We are confident that we can adopt contractual mechanisms to minimise or eradicate these risks;

- *Combination of an Inter-City operator with a commuter operator could result in the business focus being on the more commercial services to the detriment of the others.*
- *Where competition between operators has resulted in additional benefits to passengers (particularly on the quality/price issue), combination could present an opportunity to 'back track'.*

Potential solutions to these issues could include clearly specified targets for performance and service levels and (where appropriate) regulation of fares and the establishment of dedicated management units within the franchise.

Our proposed policy will not be able to capture any possible future advantages of on-rail competition. Whilst this is a potential disadvantage, we believe that it is a relatively low probability as there has been competitive stability for some time (e.g. Anglia and First Great Eastern). Much spare capacity has been consumed since 1995-96, limiting the scope for extending direct competition. Moreover, we believe that the advantages to be achieved by adopting the proposed approach far outweigh such possible disadvantages.

[http://www.sra.gov.uk/sra/news/releases/franchise/combining_franchises_130302.html]

It is not possible to evaluate this strategy from the current point of view. Actually the concentration of the policy on single operators seems to be a specific reaction to the specific problems of the British railway experiment.

The post-privatisation reform

The Hatfield incident fell in a time when it was broadly accepted that the network was in bad state but that the establishment of the SRA and the changes in the incentive regime would turn the development.

After Hatfield everyone – including Railtrack – realised that the network operator had only limited knowledge of the condition of its assets, especially the rails. Railtrack was challenged with both the revealing of an immense need for track renewal and with high penalties through the performance regime. To carry on Railtrack was granted by the Secretary of State a sum which included 1,5 bn which were originally due for the third control period 2006-11. But the sum was not enough for Railtrack to stabilise its business. When Railtrack asked for a further grant in late 2001 it was placed into administration following a successful request of the Secretary of State.

Railtrack was bought out of administration in October 2002 for 500 million by a company limited by guarantee. Network Rail seeks to re-integrate track maintenance and network management. Key maintenance decisions and the operation of inspection and day-to-day maintenance shall be transferred to Network Rail. The core activity of the new network operator shifted from management of the network to control over the network.

With franchise terms the SRA u-turned in late 2002. Had it been the strategy to negotiate 20-year terms they now cut term length back to 5-8 years. The new franchise agreements will be much more detailed about how the operators have to deliver the train services. For Bowker the trains are “a public service privately delivered” [MORTON 2003], the subsidy can then be interpreted as a management fee.

Another arguable measure to improve services is to cut the number of trains to increase punctuality.

A1.1.3 Conclusion

Lessons learned and problems identified

- Difficulty to set charges (great change in level of charges with the second review)

The level of charges was lowered by 8% in the first review and raised by 50% in the second review. The reason was that neither the Regulator nor the network had adequate information on the state of the network and the resulting expenditure need.

The literature offers different reasons for this

- the separation of the network management from network maintenance or at least a flawed contractual relationship between them
- the loss of know-how with the vanishing of British Rail
- the absence of a compound database on network assets

- Difficulty to set the right incentives with regard on traffic volume and investment/capacity enhancement

The original charging regime anticipated a shrinking market. Thus a high share of the fixed charge should distract operators from abolishing services. Partly due to fare regulation, the market happened to grow strongly in some regions. In this case the charging system lead to false incentives because the network operator did not benefit from new services and subsequently did not want to invest in additional capacity. This is true for passenger as well as for freight services.

EWS has complained that it would like to grow and invest into new rolling stock, but that Railtrack does not deliver the complementary capacity. That there is a quiet potential for investment among the TOCs was also shown by the franchise extension for South Central Trains. The franchisee offered investment into rolling stock and infrastructure worth no less than 1.5 bn in return for a 20-year-contract.

- Shifting responsibility for investment

At the beginning of the privatisation process all strategic and operational responsibility for capital projects lay on Railtrack. As Railtrack failed to deliver a satisfying level of renewal and enhancement the SRA was put in charge for strategic leadership within the industry and the planning and coordination of investment while Railtrack was still responsible for carrying out the projects. After it became clear that Railtrack could net get sufficient funding from the capital market the SRA sought to get commitments for investment from the train operators through extended franchise terms. The next step in this logic is the single operator strategy, which will allow train operators to internally optimise the bottlenecks on their route. Consequently operators could decide independently where on their route enhancement schemes they finance should take place.

Then the responsibility for investment would have shifted away from the network operator to the passenger train operators. Complementarily the focus of Railtrack – now Network Rail – has moved from managing the network to engineering the network.

- Difficulty to coordinate multiple operators (or why is there a single operator strategy?)

The British example suggests that coordination amongst different operators on one line becomes far more complex when the network is used to capacity. External effects increase in form of delay costs as well as in opportunity costs when trains cannot be allocated at all. This is why SRA aims at having only one operator on the major lines into London, so that the operator can solve path conflicts at "his" bottlenecks internally. Another benefit may be an increased incentive for the single operator to spend in route enhancement.

- Too little competition

A major reason for adopting the track authority model for privatisation was to encourage competition between different train operators. But since capacity rights were largely determined by passenger service requirements competition in the market was unlikely to evolve. Moreover the franchisees had agreed to a specific need of subsidy or even to paying a premium – based on existing services. Therefore the regulator soon found himself in a position where he had to protect SRA's clients from competition.

Data used in UK

To summarize: In the UK two main elements have been determined to approximate the variable costs of railway infrastructure use. Those are usage costs and scarcity costs.

Usage costs

1. passenger vehicle miles per vehicle type per route section
2. freight vehicle miles per vehicle type per route section
3. average speed per route section
4. vehicle weights
5. vehicle bogie and suspension types, especially unsprung mass
6. type of rail (rail weight)
7. track quality
8. line geometry (curvature)

Scarcity costs

The calculation of the capacity charge tariff is done on the basis of the NID (National Infrastructure Database). This is a detailed model of the railway network, down to the level of individual tracks and routes through stations and junctions. Encoded within the NID are the relevant aspects of the Rules of the Plan and other related information, so for every track there is data about headways, linecodes and directionality.

The statistical regression carried out for each of the relevant routes is of the following form:

$D_{it} = A_i \, e^{(bCit)}$

where:

D_{it} is the delay per train on route section i, in time band t;

A_i is a constant term estimated for each route section i;

C_{it} is the index of capacity utilisation on the route section i in time band t; and

β is the estimated coefficient for a specific route.

Appendix 2 EU railway legislation and its implementation

A2.1 EU railway legislation and its implementation

Overview

The railways across Europe have been subject to change, from integrated organisations closely related to governments into several split bodies, increasingly separated from governmental control. While the Council Directive 91/440 changed the basic organisation of railways, other measures were put to place furthering the objectives set. This brought along new challenges that the Railway world is facing today such as the fact that the automatic mechanisms of the integrated organisations have been seriously and structurally disrupted by the disintegration of railways. In fact, before 91/440 all divisions in a railway company contributed to a common objective in a hierarchical structure

These divisions have been reorganised into autonomous entities that set objectives related to their own mission. Although the latter has contributed to transparency to some extent – entities that have a clear and independent profile are easier to trace compared to the situation were they were integrated – nowadays it is hard to keep overview on the full size legal and institutional framework.

In a moment when the opening of the rail market in the Member States of the EEA, Candidate Countries and Switzerland it is important to have a comprehensive, accessible and up to date understanding about the legal, institutional and organisational framework put to place, fostering the development and proper functioning of both the rail market and the railway administrations.

Current legislation

Implications of the directives

The DIRECTIVE 2001/14/EC on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure and safety certification lays down the relevant principles and shall be implemented into national law by 15 March 2003.

Directive 2001/14's implication on infrastructure charging:

- social marginal cost pricing

  Article 7 - Principles of charging

  3. Without prejudice to paragraphs 4 or 5 or to Article 8, the charges for the minimum access package and track access to service facilities shall be set at the cost that is directly incurred as a result of operating the train service.

  5. The infrastructure charge may be modified to take account of the cost of the environmental effects caused by the operation of the train. Such a modification shall be differentiated according to the magnitude of the effect caused.

- congestion charging

  Article 7 - Principles of charging

4. The infrastructure charge may include a charge that reflects the scarcity of capacity of the identifiable segment of the infrastructure during periods of congestion.

Directive 2001/14's implication on slot allocation:

- The directive allows to dedicate specific lines of the network to specific types of service.

  Article 23 - **Specialised infrastructure**

  2. Where there are suitable alternative routes, the infrastructure manager may, after consultation with interested parties, designate particular infrastructure for use by specified types of traffic. Without prejudice to Articles 81, 82 and 86 of the Treaty, when such designation has occurred, the infrastructure manager may give priority to this type of traffic when allocating infrastructure capacity.

  Such designation shall not prevent the use of such infrastructure by other types of traffic when capacity is available and when the rolling stock conforms to the technical characteristics necessary for operation on the line.

- The infrastructure managers shall develop international train paths.

  Infrastructure managers shall cooperate to enable the efficient creation and allocation of infrastructure capacity which crosses more than one network. They shall organise international train paths, in particular within the framework of the Trans-European Rail Freight Network.

- The infrastructure managers shall reserve capacity for ad-hoc requests.

  Infrastructure managers shall where necessary undertake an evaluation of the need for reserve capacity to be kept available within the final scheduled working timetable to enable them to respond rapidly to foreseeable ad hoc requests for capacity. This shall also apply in cases of congested infrastructure." [EP 2001/14]

- The infrastructure manager may price out congestion by levying a congestion charge or employ other criteria to allocate congested infrastructure.

  Article 22 Congested infrastructure

  Where after coordination of the requested paths and consultation with applicants it is not possible to satisfy requests for infrastructure capacity adequately then the infrastructure manager must immediately declare that element of infrastructure on which this has occurred to be congested. This shall also be done for infrastructure which it can be foreseen will suffer from insufficient capacity in the near future.

  [..]

  When charges in accordance with Article 7(4) have not been levied or have not achieved a satisfactory result and the infrastructure has been declared to be congested, the infrastructure manager may in addition employ priority criteria to allocate infrastructure capacity. The priority criteria shall take account of the importance of a service to society, relative to any other service which will consequently be excluded.

The data requirements of the Directive can be summarized in a tabulated form:

Table 20: Data requirements by Directive 2001/14

Charges	Data requirements
marginal costs	the costs itself caused by train operations
congestion charging	price/time-elasticity of demand
contribution margin	the necessary level of such a margin to shift the railway infrastructure system towards a higher degree of cost coverage
Reservation fee	minimum level of this fee which prevents TOC from blocking capacities against the use of competitors; maximum level of this fee to protect the interests of the TOCs who cannot avoid each disturbance
Specialized infrastructure	demand in different markets
	marginal costs for specialized routes
International train paths	sectored demand (national / international)
capacity for ad-hoc requests	likely income through ad-hoc-traffic
	missed income through bounded capacity

In the directive 2001/14 two articles deal specifically with the principles of charging and the provision of the services to a railway undertaking (5 and 7). Below, in Annex II is described the kind of services to be provided by an IM. Finally, article 30 entails the responsibilities of control of the regulatory body to intervene regarding charges set for these services.

Annex I: Contents of the Network Statement

The network statement referred to in Article 3 shall contain the following information:
1. A section setting out the nature of the infrastructure which is available to railway undertakings and the conditions of access to it.

2. A section on charging principles and tariffs. This shall contain appropriate details of the charging scheme as well as sufficient information on charges that apply to the services listed in Annex II which are provided by only one supplier. It shall detail the methodology, rules and, where applicable, scales used for the application of Article 7(4) and (5) and Articles 8 and 9. It shall contain information on changes in charges already decided upon or foreseen.

3. A section on the principles and criteria for capacity allocation. This shall set out the general capacity characteristics of the infrastructure which is available to railway undertakings and any restrictions relating to its use, including likely capacity requirements for maintenance. It shall also specify the procedures and deadlines which relate to the capacity allocation process. It shall contain specific criteria which are employed during that process, in particular:
a) the procedures according to which applicants may request capacity from the infrastructure manager;
b) the requirements governing applicants;
c) the schedule for the application and allocation processes;
d) the principles governing the coordination process;
e) the procedures which shall be followed and criteria used where infrastructure is congested;
f) details of restrictions on the use of infrastructure;
g) any conditions by which account is taken of previous levels of utilisation of capacity in determining priorities for the allocation process.
It shall detail the measures taken to ensure the adequate treatment of freight services, international services and requests subject to the ad hoc procedure.

Annex II: Services to be supplied to the railway undertakings

1. The minimum access package shall comprise:
a) handling of requests for infrastructure capacity;
b) the right to utilise capacity which is granted;
c) use of running track points and junctions;
d) train control including signalling, regulation, dispatching and the communication and provision of information on train movement;
e) all other information required to implement or operate the service for which capacity has been granted.

2. Track access to services facilities and supply of services shall comprise:
a) use of electrical supply equipment for traction current, where available;
b) refuelling facilities;
c) passenger stations, their buildings and other facilities;
d) freight terminals;
e) marshalling yards;
f) train formation facilities;
g) storage sidings;
h) maintenance and other technical facilities.

3. Additional services may comprise:
a) traction current;
b) pre-heating of passenger trains;
c) supply of fuel, shunting, and all other services provided at the access services facilities mentioned above;
d) tailor-made contracts for:
- control of transport of dangerous goods,
- assistance in running abnormal trains.

4. Ancillary services may comprise:
a) access to telecommunication network;
b) provision of supplementary information;
c) technical inspection of rolling stock.

Article 5: Services

Railway undertakings shall, on a non-discriminatory basis, be entitled to the minimum access package and track access to service facilities that are described in Annex II. The supply of services referred to in Annex II, point 2 shall be provided in a non-discriminatory manner and requests by railway undertakings may only be rejected if viable alternatives under market conditions exist. If the services are not offered by one infrastructure manager, the provider of the main infrastructure shall use all reasonable endeavours to facilitate the provision of these services.

The minimum access package is described in detail in Annex II point 1. It includes all services needed, for a rail undertaking possessing a license and a safety certificate and fulfilling all other legislative requirements, to submit a request for capacity, for the request to be considered and for it then be able to use the capacity.

Track access to service facilities (listed in point 2 of Annex II) assures that, subject to compliance with rules that do not distinguish between rail undertakings, a rail undertaking can access the facilities listed. The rail undertaking can use the tracks to and in the facilities. A range of different facilities are listed in Annex II point 2.

The supply of services covers the use of the facility and the normal services supplied to rail undertakings in those facilities. This means that for instance a freight terminal with lifting equipment and staff who operate it, a rail undertaking can expect to be able to use these services. A request to be supplied with any of these services can only be refused if a market alternative exists.

The Directive aims to ensure a *non-discriminatory* access to and use of facilities and services. To achieve this requires the use of track connecting the facility to the main infrastructure as well as any track within the facility itself. The competition rules of 2001/12 (91/440) are of course applicable to the supply of all services to railway undertakings. This prohibits an undertaking in a leading position to use that power to impose unfair prices or other trading conditions, thereby placing them at a competitive disadvantage. In many cases the supplier of services to railway undertakings is likely to be in a dominant position and therefore they will be obliged to ensure that all of their customers are treated fairly. Nevertheless, the requirement in this article in relation to points 1 and 2 of Annex II goes further because the obligation to supply the services on a non-discriminatory basis applies even where there isn't a leading position. This is why there is a distinction between points 1 and 2 services and other services in Annex II.

Depending on the service being sought, *a viable alternative* will need to offer services that broadly meet the needs of the rail undertaking and not prevent it from operating rail transport services that it could have operated using its preferred facility.

In the case that a railway undertaking owns a station or a terminal, that is, it has the necessary access rights to provide a service for which the access of facilities are required then that particular rail undertaking cannot refuse the use of them. Except in cases where a "viable market" alternative is available. This of course, does not mean that the rail undertaking seeking the use of the facility has the right to dictate the conditions. The owner has a reasonable right to manage and run the facility in his business interests. Member states must therefore ensure that the Regulatory Body has the power to intervene where disputes arise in this area.

When article 5 refers to *market conditions* this would entail where there was competition between suppliers of the service. Pricing under market conditions implies the ability to achieve a reasonable return on the capital engaged, but it also implies on the ability to levy excessive charges. The latter might occur because a facility was perhaps the only alternative to that of the leader railway undertaking.

Where *reasonable endeavours* are concerned, it is at least expected that the IM would maintain a database of all suppliers of facilities, services and indicative prices. If the IM chooses it was in his best interest to act as an intermediary to facilitate a rail undertaking organizing its operations if he chose to do so, this is likely to exceed the obligatory requirement by the directive. At present, regarding the existence of *alternative suppliers of services*, it would be reasonable for a rail undertaking to have the right to choose the supplier that best suited their needs. Consequently, a rail undertaking with the legal right to operate a service cannot be refused a service listed in Annex II point 2 unless there is a viable alternative, even if it has not yet been granted infrastructure capacity for the service. The operator of the service must be prepared to agree conditions on the basis that appropriate infrastructure capacity will be granted. In case there is no available capacity the rail undertaking has the right to ask the Regulatory Body for an assessment of whether it was not equally treated.

An infrastructure manager shall offer any range of the services described in Annex II, point 3 as additional services upon request to a railway undertaking

An infrastructure manager or an other supplier, is not obliged to provision the ancillary services described in Annex II point 4

Article 7 & 8: Principles of Charging and Exceptions

Charges for the use of railway infrastructure shall be paid to the infrastructure manager and used to fund their business.

Member States may require the infrastructure manager to provide all necessary information on the charges imposed. Thus imposing a transparency in accounts, in this regard, IMs must be able to justify that infrastructure charges are actually invoiced to each operator, pursuant to Articles 4 to 12, comply with the methodology, rules, and where applicable, scales laid down in the network statement. Infrastructure managers must publish a network statement containing the following information in particular:

The nature of the infrastructure available to railway undertakings;

The conditions for access to this infrastructure;

The charging principles (scheme in force, likely changes over the next five years, etc.);

The capacity allocation criteria and rules (capacity characteristics, any restrictions, procedure for applying for capacity, etc.);

The procedures and deadlines to be followed.

Charges are set and collected by an independent charging body; generally the infrastructure manager provided it is not dependent on the railway undertakings.

The directive lays down charging principles:

Charges must be paid to the infrastructure managers and used to fund their business;

In principle, the charge for the use of railway infrastructure equals the cost directly incurred as a result of operation of the trains;

The infrastructure charge may include a sum reflecting the scarcity of capacity

The infrastructure charge may be modified to take account of the cost of the environmental impact of operation of the trains.

Annex II basically refers to the “services to be supplied to the railway undertakings”. Fundamentally, this refers to:

The supply of services described in Annex II point 2. It is therefore reasonable to conclude that any service described in the list under point 2 that is supplied to a rail undertaking comes within the scope of article 7(7). The charges for the track access to services are however covered by paragraph 3 mentioned above.

By stating that the supply of services referred to in Annex II, point 2, shall not be covered by this article (7 §7), basically means that the other requirements of this article do not apply to these services. This means that charges for them do not have to follow the rules set down in paragraphs 1 to 6 of the directive. Instead, it should be taken into account that charges require account to be taken of the competitive situation of rail transport. This recognizes that some of these facilities may be run by undertakings that need to cover their full costs though the charges levied. There is likely to be a degree of monopoly power that should not be abused while setting the charges.

Concerning paragraph 8, in the case where there in not a monopoly of service providers, market forces should then operate to determine the price at which the service is supplied. Where the supply of these services is performed by a monopoly, the provision of Article 7 paragraph 8 comes into force and limits the cost of the service to the cost providing it. This should be the full cost of providing the service, not the marginal cost, since otherwise the provider of the service cannot cover his fixed costs and overheads. The “cost of providing the service” should include a reasonable rate of return to ensure that the provision of the service can be affordable.

A railway undertaking and an infrastructure manager may enter into a framework agreement. This will not specify a train path in detail but should meet the commercial needs of the authorized applicant. The agreement may be concluded for no longer than five years, may not preclude use of the infrastructure by other railway undertakings and may be amended.

The right to use railway infrastructure is granted by the infrastructure manager concerned. The infrastructure manager also allocates the available capacity which, once allocated, may not be transferred to any other undertaking by the recipient.

The rights and obligations of the infrastructure manager and of the authorized applicants are laid down in a contract.

Directive 2001/14 also contains provisions on:

- Compensation schemes for unpaid environmental, accident and infrastructure costs;
- A performance scheme;
- Capacity reservation charges (for capacity booked but not used).

Regulatory Body (Article 30 § 2 and 4)

The regulatory body is able to intervene in respect of charges set for the services provided to rail undertakings. Paragraph 2 of article 30 states that an applicant can "…appeal to the regulatory body if it believes that it has been unfairly treated, discriminated against or is in any other way aggrieved…" This provides a wide ranging right of appeal that includes services covered by Annex II. Paragraph 4 gives the regulatory body the power to request information not only from the IM and rail undertaking but any third party involved.

While there is no specific requirement for the regulatory body to supervise the setting of these charges, it is desirable that regulatory bodies be established with more power that the absolute minimum.

Data Availability and Reliability

Most IMs use software like SAP R/3 (and follow-ups) for internal data management, which could enable to build a common platform for effective data exchange. Those systems also provide a necessary precondition to ensure the independence of the path allocation process from transport operations and the accountability of different services.

According to the requirements from the EU railway package the regulators form specific criteria to the IMs

- how to structure and how to calculate an infrastructure charging system
- how to allocate slots in case of path conflicts (slot allocation system)
- how to set up a timetable (timetabling system).

In addition to that the IM are obliged to publish the key data leading to their infrastructure management systems.

Harmonisation of charges

Council Directive 95/19/EC as amended by 2001/14 contains broad rules that set the Community framework governing the charging of railway infrastructure fees. There are however substantial differences between the approaches to rail infrastructure charging adopted so far by individual Member States as well as substantial differences in the consistency of Member States charging systems with EC rules.

Four countries have been analysed while summarizing the results on conformity assessment we can report the following:

- Except Germany, the charging rule for the minimum access package is marginal cost pricing consistent with EC rules.
- The charging rule for supply of services is based on the competitive situation of rail transport, as EC rules determine.
- When a country charges for additional services, like Germany and Switzerland, it charges on the basis of the actual level of use, as determined by the Community.
- There is no evidence so far for ancillary services charging.

The actual charging system followed by 4 of the major European Infrastructure Managers, is presented below.

Austria – Österreichische Bundesbahn (ÖBB)

Austria changed from a dual part charging system to a linear part system in 1999. Today ÖBB charges two obligatory price components:

- one considering wear and tear with gross ton kilometres (gtkm)
- one charged according to train-kilometres

ÖBB currently uses higher charges on mountain lines, thus depending on the line type/train path.

Austria founded an association for the financing of railway infrastructure. The Schieneninfrastruktur-Fianzierungsgesellschaft´s (SchiG) tasks are:

- to set the charging system,
- to market the track network and
- to contribute to the financing of line upgrading or new lines incl. signals, stations, noise reduction, etc.

An improved charging system is currently under development. It is planned to be introduced in early 2003.

The new system will maintain the two parts - one charged on the basis of train-km, the other on gtkm – but will differentiate the price per train-km according to various features of the train or the train path.

Both, the price charged on train-km and the one charged on gtkm reflect marginal costs – for train operation and maintenance respectively. There settling was preceded by cost studies. To the costs of train operation an extra charge according to the line used is added. These three components give the base price of a train path.

Up to three surcharges can be added to the base price. These reflect track scarceness and willingness to pay, and give an incentive to use track-friendly rolling stock

Table 21: Structure of ÖBB's charging system

Price Component	Economic Aspect	Indicator	Charged per …	Price
Train Operation	marginal cost of operation	train-km	train-km	not known yet
Tear and Wear	marginal costs of maintenance	not known yet	gross ton km	not known yet
Line Category Surcharge	infrastructure quality based	not known yet	train-km	
High Demand Surcharge	track scarceness	not known yet	train-km	
Train Category Surcharge	willingness to pay	not known yet	train-km	not known yet
Tear and Wear Surcharge for certain Vehicles	marginal costs of maintenance	not known yet	train-km	

Table 1 gives an overview on the new price components. Please note, that the new charging system is still "under construction" and no detailed indicators or prices are known yet.

Belgium – Societé Nationale de Chemin de Fer Belge (SNCB)

The SNCB uses in a linear charging system two base components – one for the **use of lines**, the other for the **use of stations**. Both are multiplied with various coefficients, according to train type, load or commercial value.

Basic line charge

The basic charge per km is determined for each section by multiplying a unit price with two coefficients:

C1 is a coefficient relating to the commercial significance of the section. Railway lines were ranged, among other things, according to the overall (passenger plus freight) yearly revenues per km.

C2 is a coefficient relating to the technical equipment on that section and thus to the investment and the cost of maintenance. C2 may be reviewed after infrastructure improvements have been carried out.

Charge per train

For each train taking a line section, a charge is then calculated in multiplying the basic charge for that section by four coefficients:

- **C** is a coefficient relating to the overall gross load of the train. It is used to take account of the wear caused by trains to the infrastructure (tracks, points, catenary, signal boxes…).

  C is set by train weight classes as shown in table 2.

Table 22: Gross load coeffisient of SNCB

Category	Tonnage	Mean	Coefficient C
1	0 - 400	200	1.2
2	401 - 800	600	1.6
3	801 - 1200	1000	2.0
4	1201 - 1600	1400	2.4
and so on	and so on	and so on	and so on

- **Pt** is a coefficient that depends on the quality of the service offered by the IM and in particular on the priority level allocated to the train in comparison with the other runs, especially in case the train movement is disrupted.
- **H** is the coefficient according to the time and day on which a train is running on a specific line section. Its purpose is to tune the infrastructure charge to time-related variations so as to increase the efficiency and/or to discourage customers from asking for runs that would take place during periods with heavy traffic (conduct of demand).
- **T** reflects the difference in duration of the journey of a train on a line section as anticipated and the duration of the journey according to the standard path. This coefficient is provisionally equal to **1** (no difference taken into account).

An overview of the price components which apply to the use of lines is given by table 3 below.

Table 23: Structure of SNCB's charging system for lines

Price Component		Economic aspect	Indicator	Charged per…	Price or Coefficient on Unit Price
Unit Price		unit price	train-km	train-km	0,25 € (1.1.2000)
C1	Commercial Significance	commercial significance	yearly revenue per line km	train-km	1,0 … 2,0
C2	Technical Equipment of the Line	capital costs	max. operating speed (amongst other indicators)	train-km	0,75…5,0
C	Gross Train Weight	marginal wear and tear costs	gtkm	train-km	1, 2…*)
Pt	Type of Train	willingness to pay	priority in path planning and operation	train-km	1,0…2,0
H	Time of Use	track scarceness	Traffic density	train-km	1,0…2,0
T	Relative Speed	opportunity costs	not yet implemented	train-km	not yet implemented

*) steadily increasing with train weight

Charge for the use of stations and terminals

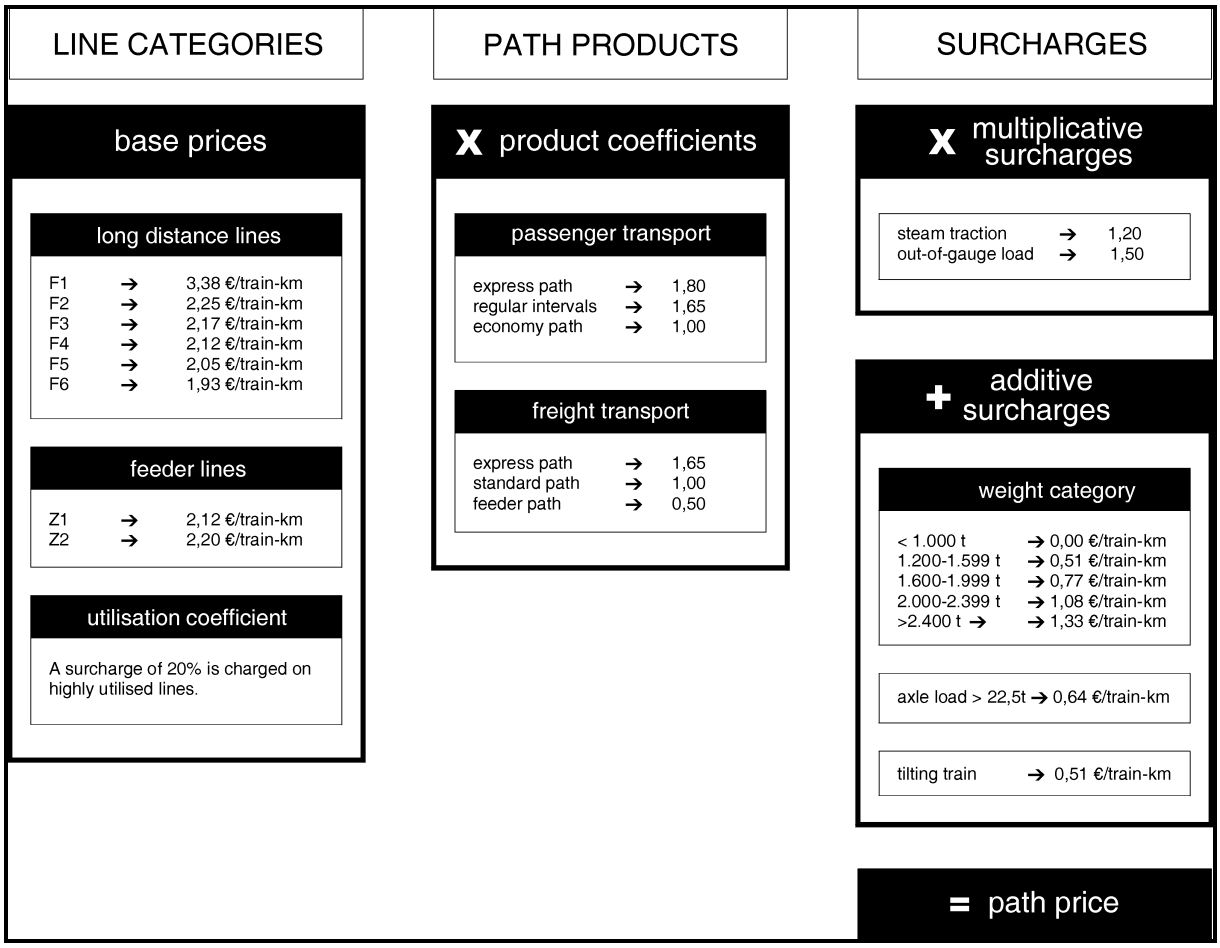
The stop at an installation (station, terminal, port) is charged separately. A differentiation exists according to the nature of the stop, the type of the train (passenger/freight) and number of trains that use the station per time, thus its commercial value or the track shortness.

Germany – Deutsche Bahn Netz AG (DB Netz)

The infrastructure charging system of DB Netz is a linear tariff, which settles the price of a slot (track time) in three steps (see figure 6):

- Settling of a base price dependant on line categories,
- Multiplying of a product factor and
- Multiplying and/or adding additional factors.

Figure 13: Charging Structure of DB Netz



Source: DB Netz

Line Categories and Product Categories

The **line categories** reflect the technical standard of the line as well as its functional role in the network. The most important indicator for the technical standard of a line is the maximum velocity. A surcharge of 20% is charged on highly utilized lines to manage demand

Table 24: Structure of DB Netz' charging system

Price Component	Economic Aspect	Indicator	Charged per…	Price or Coefficient
Line Category	Infrastructure quality and willingness to pay	max. operating speed, equipment and line function	train-km	1,93 … 3,38 €
High Demand Surcharge	track scarceness	traffic density	train-km	1,2
Product Category	willingness to pay	priority in path planning and operation	train-km	0,5 … 1,65

The **product categories** reflect the priority a path from route planning to delay management, and the mean velocity of the path:

- **Express paths** Fast and direct path between big metropolitan areas. This path has highest priority in timetable planning.
- **Standard paths** are available to all freight trains. Owing to the low priority there are few choices in timetable planning and therefore little flexibility for the train operator. Because of the priority of express (through) paths standard paths are constructed primarily between close junctions in the network but typically connecting standard paths beyond a certain junction are available to facilitate long distance.
- *A* **feeder path** must be connected to a standard or express path. It is provided solely for the distribution or collecting of wagons.

Surcharges

There are both additive and multiplicative surcharges:

- Out-of-gauge load: Trains that exceed the regular gauge may disarrange train paths on other tracks and cause higher planning expenses. Therefore a coefficient of 1.5 is multiplied on the line charge.
- Train Load over 1200 t:
- Lines which can bear axle-loads over of 22,5 t need a superstructure above normal German standards. Trains exceeding this axle-load cause extra capital and maintenance costs and are charged an extra 0,64 €/train-km.

Switzerland – Schweizerische Bundesbahn (SBB), Bern-Lötschberg-Simplon-Bahn (BLS) and other Railways

The tariff of the Swiss railtrack organizations is regulated by the "Bundesamt für Verkehr" (BAV – Federal Transport Administration). It consists mainly of two parts:

- the marginal costs of the train run (= minimal price) and
- a capital cost coverage factor.

Additional charges are raised for various services related to railway operation; including the handling and storage of wagons, brake trials etc.

Marginal Costs

The marginal costs determine the minimal price to be paid. They are composed of three parts:

- maintenance costs which on the base of gross ton km 0,0017 €/gtkm,
- train operation costs, which include trackside operating staff and are charged on the base of train-km 0,273 €/train-km ,
- energy costs which differ according to train weight and train type (fast accelerating local trains have the highest price per gtkm) 0,0017 … 0,007 €/gtkm,
- (lump sums for use (stopping or passing) of a junction. Big and small junctions are differentiated. Whether a station is counted as a junction depends on the number of diverging lines and the number of switches).

Table 25: Structure of SBB's/BLS's Charging System

Price Component	Economic Aspect	Indicator	charged per…	price *) or coefficient
Minimal Price				
Maintenance	marginal maintenance costs	fixed price	gtkm	0,0017 €
Train Operation	marginal operation costs	fixed price	train-km	0,271 €
Energy Supply	marginal energy costs	train type	gtkm	0,0017 – 0,007
Use of a Junction	marginal staff and maintenance costs	number of lines and switches	dep. + arr.	2,030 / 3,383 €
Contribution Margin				
Contribution	willingness to pay capital costs	fixed price	ntkm	0 - 0,0035 € **)
Relative Speed Surcharge (BLS only)	opportunity costs	number of regular slots used	train-km	1,35 / 2,71 €

*) Exchange rate by 1.1.2002.

**) The contribution in some cases is assumed by BAV.

Contribution Margin

The contribution margin for cargo services is 0,0052 €/net-ton-km while the one for non-regular passenger service is 0,0027 €/timetable-km. Additionally the BLS charges an extra fee for slow trains which use more than one slot (of regular speed).

Contract flexibility and adaptation mechanisms

The key question of this section is how changes in demand, traffic situation or political climate changes can be absorbed into a contract while at the same time maintaining the amount of rigidity that a contract needs to have in order to be effective. As sketched above Service level agreements are a necessary instrument to make aware the inter-relationship of cost and benefits of infrastructure management to the IM.